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## THE STUDY OF MAN<sup>1</sup>

By Professor L. J. HENDERSON

HARVARD UNIVERSITY

THE subject of this address is neither man nor the propriety or the appropriateness of the study of man; it is that study itself. It is not an examination of what chiefly interested Pope and Bolingbroke; it is a consideration of certain biological and social sciences. It is not even primarily the study of man; it is the study of men as organisms, of their structures and functions, in sickness and in health, and of men as persons, in their activities and their interactions; for the characteristics of man are but the uniformities observable among men. Again, our subject is not the examination of what such studies ought to be; it is merely a fragment of a description and analysis of what they are, of how they have been, and of how they have not been, effectively prosecuted. Let us

note at once that effective work involves both doing what is effective and not doing what is not effective.

The study of men—even the scientific study—is ancient and respectable. It goes back to Aristotle, to Hippocrates and beyond them to obscure beginnings. To-day it is one of the chief studies of the learned. Like our other activities, it may be divided into two parts, the successful part and the unsuccessful part. Speaking very generally and with due regard to numerous and important exceptions, it may be said that the successful part of the scientific study of men is related to medicine, the unsuccessful part to philosophy and to the social sciences. These relations are not only historical, they are also to be seen in methods, attitudes and traditions.

The successes of medicine and the medical sciences have not been lightly won; from a multitude of failures

<sup>1</sup>This address delivered at the University of Pennsylvania Bicentennial Conference, September 18, 1940.

they are the survivals, the fortunate productions of the best or the most-favored men among an endless succession of skilful physicians. Though pedantry, incompetency and charlatanry have often hindered and in evil times, even for long periods, arrested the accumulations of medical science, since Hippocrates, at least, the tradition of skilful practice has never been quite lost—the tradition that combines theory and practice. And this tradition is, especially in three elements, indispensable.

Hippocrates<sup>2</sup> teaches first, hard, persistent, intelligent, responsible, unremitting labor in the sick room, not in the library: the all-round adaptation of the doctor to his task, an adaptation that is far from being merely intellectual. This is adaptation chiefly through the establishment of conditioned reflexes. Something like it seems to be a necessary part of the mastery of any material or of effective work in any medium, for such adaptation is the mark of every master-workman in every field. Galileo refers to it among artisans, saying:<sup>3</sup> "Indeed, I myself, being curious by nature, frequently visit [the arsenal of Venice] for the mere pleasure of observing the work of those whom, on account of their superiority over other artisans, we call 'first rank men.' Conference with them has often helped me in the investigation of certain effects including not only those which are striking, but also those which are recondite and almost incredible." A similar adaptation is not less evident in the most abstract of the sciences—in mathematics. What, indeed, can be done in mathematics by one who lacks complete intuitive familiarity with the symbols and operations of the science, by one who must constantly think of and be aware of what he is doing and how he is doing it?

Hippocrates teaches, secondly, accurate observation of things and events, selection, guided by judgment born of familiarity and experience, of the salient and the recurrent phenomena, and their classification and methodical exploitation. This is descriptive science. It is not necessary for the craftsman, it is for the scientist. The more complex the things studied by a science, the greater—in general—the importance of descriptive knowledge. For example, taxonomy is more important to zoology than description to mechanics. In the scientific study of men much systematic descriptive knowledge is almost everywhere indispensable.

Hippocrates teaches, thirdly, the judicious construc-

<sup>2</sup> In speaking of Hippocrates, I mean the author or authors of the so-called genuine works of Hippocrates, and wish to express no opinion about the man of that name, whose life is little known. We need here feel no concern for the question whether this man wrote these works.

<sup>3</sup> "Dialogues Concerning Two New Sciences," Macmillan, New York, 1914, p. 1.

tion of a theory—not a philosophical theory, nor a grand effort of the imagination, nor a quasi-religious dogma, but a modest pedestrian affair, or perhaps I had better say, a useful walking stick to help on the way—and the use thereof. Theoretical science is not necessary for the craftsman, or, perhaps, for the descriptive scientist, because both may think in terms of the world of common sense. But theory in the form of some kind of an abstract conceptual scheme seems to be necessary for the effective exploitation of even descriptive science.

All this may be summed up in a word: The physician must have, first, intimate, habitual, intuitive familiarity with things; secondly, systematic knowledge of things; and thirdly, an effective way of thinking about things.

Experience shows that this is the way to success. It has long been followed in studying sickness, but hardly at all in studying the other experiences of daily life. Let us, therefore, consider more carefully what Hippocrates did and what he did not do. He was in reaction chiefly against three things: first, against the ancient, traditional myths and superstitions which still prevailed among the physicians of his day; secondly, against the recent intrusion of philosophy into medical doctrine; thirdly, against the extravagant system of diagnosis of the Cnidian School, a body of contemporary physicians who seem to have suffered from a familiar form of professional pedantry. Here Hippocrates was opposing a pretentious systematization of knowledge that lacked solid objective foundation; the concealment of ignorance, probably more or less unconsciously, with a show of knowledge. Note well that such concealment is rarely altogether dishonest and that it may be practiced in thorough good faith.

The social sciences to-day suffer from defects that are not unlike the defects of medicine to which Hippocrates was opposed. First, social and political myths are everywhere current, and if they involve forms of superstition that are less apparent to us than the medical superstitions of long ago, that may well be because we recognize the latter class of superstitions for what they are while still accepting or half-accepting the former class. Secondly, there is at least as much philosophy mingled with our current social science as there was at any time in the medical doctrines of the Greeks. Thirdly, a great part of the social science of to-day consists of elaborate speculation on a very insufficient foundation of fact.

Hippocrates endeavored to avoid myths and traditional rules, the grand search for philosophical truth, the authority of philosophical beliefs, the concealment of ignorance with a show of systematic knowledge. He was concerned first of all not to conceal his own ignorance from himself. When he thought abstractly, or in general terms, his thought was limited and con-

strained because he had wide intuitive knowledge based on the habit of responsible action in concrete situations. There is a test for this kind of thinking: the question, "For example?" Those who generalize from experience almost always pass this test; others do not. Indeed, the test is frequently destructive of unfounded generalization and is apt to lead to painful embarrassment. For this reason its use is often inexpedient.

Experience shows that there are two kinds of human behavior which it is ordinarily convenient and often essential to distinguish:

The one is thinking, talking and writing, by those who are so familiar with relevant concrete experiences that they can not ordinarily forget the facts, about two kinds of subjects. These are: first, concrete observations, and observations and experiences which are representable by means of sharply defined or otherwise unambiguous words; and secondly, more general considerations, clearly and logically related to such concrete observations and experiences.

The other kind of behavior is thinking, talking and writing about vague or general ideas or "concepts" which do not clearly relate to concrete observations and experiences and which are not designated by sharply defined words. On the whole, the works of Plato belong to this second class, the Hippocratic writings to the first class.

The so-called genuine works of Hippocrates reveal a method in the exploitation of everyday experiences with the lives and deaths of men that can never be too carefully studied. In the beginning are the cases, the clinical records of the great physician. They consist of bare observations of bare facts, uncolored by theory or presupposition and condensed to the very limit of possible condensation. These are the practicing physician's data, freed so far as possible from everything that is not a datum. The data are of two kinds: the first kind, often contained in the first part of the record, are single observations; the second kind, commonly presented at the end, are observations of uniformities throughout a particular sickness of a particular person.

The next step, after the recognition of uniformities in a particular case, is the recognition of a wider kind of uniformity: the recurrence again and again in different cases, often otherwise very various, of single events or of the uniformity observed within a single case, for example: regularities in the duration of certain fevers, the frequent discharge of fluid through the nose in what we now call diphtheria, and in general the prognostic importance of a wide range of symptoms. The most famous of all the descriptions of such uniformities is that known as the "*facies Hippocratica*," the appearance of the face at the point of death in many acute diseases: "Nose sharp, eyes

hollow, temples sunken, ears cold and contracted with their lobes turned outwards, the skin about the face hard and tense and parched, the colour of the face as a whole being yellow or black."

Throughout a great part of his work Hippocrates is thus moving step by step toward the widest generalizations within his reach. In great part he is seeking a natural history of acute disease, or at least of those acute diseases that were prevalent among his patients. His success was great, and the whole history of science goes far to support the view that such a methodical procedure is a necessary step in the development of a science that deals with similarly complex and various phenomena.

Beyond this stage there is one even wider generalization that plays an important part in the writings and thought of Hippocrates. This is the principle that came to be known, and is still remembered, as the *vis medicatrix naturae*. It may be stated in modern form as follows: Organisms exist in a state such that when a modification, not too great and different from what will otherwise occur, is impressed on them, a reaction appears tending toward the condition that would have existed if the modification had not been impressed. This is by no means only true for organisms, and indeed it has been more clearly recognized in recent years by certain economists in their theoretical studies than by physicians and physiologists.

In order to construct a useful conceptual scheme, Hippocrates proceeded to analyze this process, as he abstractly conceived it, into elements. His analysis and the resulting elaboration of the theory need not detain us. To them we owe the survival of such words as "crisis" and "coction." But the theory, having served its purpose, is obsolete, like Ptolemy's astronomy.

We must, however, note carefully that this obsolete theory, like so many others, once served its purpose well. In particular, it was the firm support of the Hippocratic principle of expectant treatment and of the precept "Do no harm," a principle and a precept which still preserve their utility in the practice of medicine and even in government and the affairs of everyday life, and which are too often disregarded by physicians, surgeons and politicians.

The Hippocratic conceptual scheme suffers from one particular defect that should be carefully noted: It presents a view of the physiological system in a state of equilibrium, without giving a satisfactory picture of the constituent parts of the system or of the forces that operate between these parts. We now know that it is convenient and reasonably satisfactory to think of the constituent parts as chemical substances, fluids, cells, tissues and organs; and of the forces as the forces with which theoretical physics and theoretical

chemistry are concerned. Such a conception was not available to Hippocrates. Nevertheless, his conceptual scheme worked and for a long time worked well. This is, in fact, the test of a conceptual scheme and the only test: it must work well enough for the purpose of the moment. A conceptual scheme survives just so long and just in so far as it continues to be convenient to use it for the purpose of scientific work.

In a discussion of scientific hypotheses, Henri Poincaré once remarked: "These two propositions, 'the external world exists,' or 'it is more convenient to suppose that it exists,' have one and the same meaning." The proof of Poincaré's assertion is that in scientific work no use can be made of the proposition "the external world exists" that can not just as well be made of the statement "we assume for the present purpose that the external world exists." Moreover, all our conceptual schemes are in a state of flux. There is hardly one we now use that was used in precisely its present form fifty years ago. It is therefore dangerous to believe that a conceptual scheme is a description of some ultimate metaphysical reality. In other words, belief in the "truth" of a conceptual scheme is for scientific purposes not only irrelevant, it is often misleading.

Our modern theory and our modern practice of medicine are so different in so many ways from ancient theory and practice that only by an effort of thought and imagination can we clearly conceive what ancient medicine was. I have tried to suggest that its merits were great and to specify the nature of some of these merits. To specify its deficiencies is almost unnecessary. However, we may note that until long after the time of Hippocrates experiment was but a feeble aid to observation and that applications of physics and chemistry were altogether lacking because there was nothing to apply.

In our modern period all this is changed. The sciences of anatomy, physiology and pathology, with their many branches, have grown up. They have become experimental sciences and they are becoming more and more sciences of applied physics and applied chemistry. This development has been accompanied by the growth of a conceptual scheme in which the broader generalizations of the medical sciences are incorporated and synthesized.

But it is still true that the investigator must have intimate, habitual, intuitive familiarity with the things that he studies, systematic knowledge of them and an effective way of thinking about them. This is just as true in the anatomical laboratory or the physiological laboratory or the pathological laboratory as it is in the clinic. There is, I believe, no broader induction

from our experience of scientific work than this, and few inductions are more important.

The present state of the medical sciences, and indeed of each one of their many principal branches, is the accumulated result of innumerable experimental researches and descriptive studies. In general, each of these departments of science has grown up through the concerted labors of hundreds or thousands of intelligent specialists working with methods that are a part of their professional skill and that are more or less common to them all, working also with a conceptual scheme with which all are familiar. This aggregate of theory, like the methods, evolves and adapts itself to the state of the science produced by the work that has already been done. There is reason to believe that these are necessary conditions for the development of any science and, above all, for any science that deals with very complex phenomena. At all events, there seems to be no example of a highly developed science that is not the product of the labors of many men working skilfully in parallel and in succession with methods, systematic descriptions and classifications that they share. In the early stages of a science the theories are crude and the classification simple. They grow by trial and error and by adaptation into more refined theories and more complex descriptions. In short, the growth of the medical sciences, like that of all sciences, was not planned. That which survives does so because it is adapted to the needs of the scientists. In the development of a science facts when well established are always adaptations. On the other hand, theories and classifications survive, as Mach long ago pointed out, largely because they economize thought and effort, perhaps in some measure, also, because they are felt to possess what mathematicians call elegance.

There are certain deficiencies of the medical sciences to which little attention has been devoted, partly because they are inevitable in sciences that have grown up as these have grown up, partly because of the immense success that has been achieved by doing things as they have long been done, partly because of the peculiar difficulties involved in working effectively to remedy these deficiencies, and partly because such work is different in kind and in method from most of the work to which investigators are accustomed. These deficiencies depend upon the fact that living organisms are immensely complex and that the experimental sciences, by hook or by crook, analyze the concrete reality into relatively simple elements. But the complex reality is never describable by merely adding up these elements, for they exist in a state of equally complex interaction. In a man, as in a machine, effective description involves both a knowledge of the parts and a knowledge of how these parts interact. Moreover, in organisms not only are the parts very numer-

<sup>4</sup> "La valeur de la science," Paris (no date), p. 272.

ous but their interactions are especially numerous. Indeed, many biological adaptations consist precisely in the establishment of new interactions between parts.

Consider the case of hemoglobin. This substance is the sole carrier of oxygen, apart from merely dissolved oxygen, in the blood. Many years ago the conditions of the equilibrium governing the combination of oxygen with hemoglobin were satisfactorily determined. It was then discovered that the affinity of hemoglobin for oxygen is modified when the pressure of carbonic acid, or the alkalinity of the blood, or any one of several other things varies. Next, it appeared that the interaction between oxygen and carbon dioxide, previously unsuspected but revealed by this discovery, greatly enhanced the efficiency of the blood as a carrier of both oxygen and carbon dioxide. In short, this interaction is an adaptation. Finally, it became possible to piece the facts together with the help of mathematical methods and to describe the interaction quantitatively.

The problem of describing the interaction between these two substances in blood was in certain respects a different problem, involving different procedures, from the problems involved in the earlier studies. In particular, it was a problem that could be solved only by the use of certain mathematical procedures appropriate to the treatment of a system in which several factors in a state of mutual interaction are involved. This is a simple case and a mere partial description of almost any interaction in biological systems presents far greater difficulties, yet even here the difficulties were great enough to make the use of special mathematical methods necessary.

When we possess adequate knowledge of a system in which  $n$  factors are involved and have arrived at a description of this system in terms of the  $n$  factors, so that their interactions are also described, it is possible to reason successfully concerning changes in the state of the system in so far as these  $n$  factors alone are concerned, to a given approximation, in the process that is being studied. But when a further factor is also involved our reasoning can never be trusted and is in general illusory. It is perhaps partly for this reason that anatomists, physiologists and pathologists do not practice medicine, and this is probably the principal source of the familiar attitude of suspicion toward the laboratory sciences that may be seen among experienced clinicians. When men reason deductively about the complex affairs of everyday life they nearly always leave out something, or rather many things, both things they forget and things they don't know. More often than not their conclusions are therefore ungrounded. This is what Whitehead calls "the fallacy of misplaced concreteness." I am not sure that it can be appreciated by any one who has not experienced the

difficult task of putting together the pieces obtained by analytical studies and thus building up an adequate description of a system in which many factors interact. Experience alone can teach most people the immense complexity of interactions between many factors, and the mathematical solution of such problems seems to be the only means of clearly conceiving the nature of such phenomena. However, it may be well to consider a simple illustration.

The fallacy of misplaced concreteness is very common in the form of arguments involving "other things being equal." Suppose one is concerned with the correlation between values of two variables, say,  $x$  and  $y$ . Suppose, further, that it is assumed either that nothing else need be considered or that, other things being equal, this correlation must have a single value. In order to fix our ideas, let the case be such that the unknown relations between  $x$ ,  $y$ , and the other things can be expressed by the equation

$$y = \frac{x+z}{x+2}$$

in which the value of  $z$  is a measure of the other things, say,  $u$ ,  $v$ ,  $w$ , or in other words  $z$  is a function of these other things, that is,  $z$  varies when either  $u$  or  $v$  or  $w$  varies.

Let us now give  $z$  successively the three values 1, 2 and 3. Then:

$$(1) \quad y = \frac{x+1}{x+2}$$

$$(2) \quad y = \frac{x+2}{x+2}$$

$$(3) \quad y = \frac{x+3}{x+2}$$

These equations are represented graphically on Fig. 1.

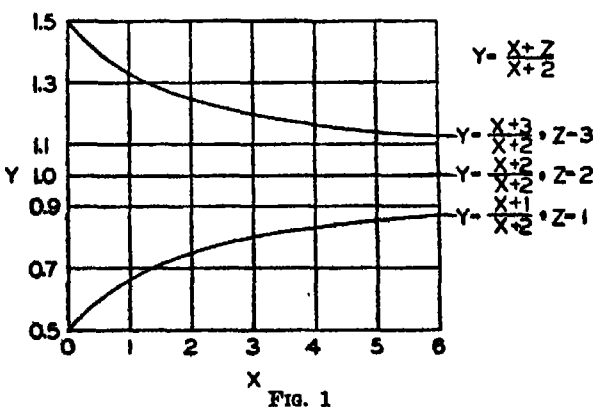


FIG. 1

Evidently when  $z=1$ ,  $x$  and  $y$  are positively correlated; when  $z=2$ , they are independent, for  $y$  is constant while  $x$  varies; when  $z=3$ , they are negatively correlated. Accordingly, any statement about the correlation of  $y$  with  $x$  must take account of what happens when  $z$  varies or must specify the value of  $z$  at which other things are equal. But  $z$  is a function of

$u$ ,  $v$  and  $w$ , which makes for further complications. In general, it may be said that all arguments involving such notions as other things being equal, or *pari passu*, are probably fallacious except when the universe of discourse is arbitrarily limited by abstraction, as in mathematics and theoretical science. There is never any reason to suppose that until the conclusions have been well tested such reasoning can be safely applied to the complex reality of daily life, especially in that part of reality with which either the medical sciences or the social sciences are concerned.

Imagine two men setting to work, one on January 1, the other on July 1, to measure the duration of daily sunshine. Each might well find after three or four months a high correlation between time (i.e., date) and duration of sunshine. But the first would observe a positive correlation, the second a negative correlation. Neither would be likely to deceive himself on this account, *because he has intuitive familiarity with the things in question and systematic knowledge thereof*, but if he were dealing with a like result from the study of unfamiliar phenomena he would probably fall into error, unless he appreciated the danger of the fallacy of misplaced concreteness.

The medical sciences have suffered and continue to suffer from this fallacy. The rise of bacteriology and its influence upon medical thought and practice may be taken as an example. About the time of Pasteur's first discoveries, the thought of Claude Bernard and of other physiologists seemed to indicate a movement toward the study of the interrelations between many things and a recognition of this kind of study, synthetic physiology, as one of the foundations of the medical sciences and as the source of an indispensable point of view in all kinds of medical work. The discovery of specific pathogenic microorganisms seems to have led back to an oversimplification of thought about the origin and nature of disease. For some time at least, the tendency was to think of diseases as entities hardly less definite than atoms of oxygen or molecules of hemoglobin. Let us recall the fact that even hemoglobin *in situ* is not a single definite thing. The disposition was even more marked to think of the specific organism as the cause—the sole cause—of a specific disease and later to think of the specific antitoxin as the specific cure of that disease. Similarly, simple views of nutrition have prevailed. There was the epoch of calories; we now live in the epoch of vitamins. Hormones also are now having their day, and excess or deficiency of specific hormones, like excess or deficiency of particular vitamins, is often thought of as the cause of a specific disease.

All this oversimplified thinking has flourished and survived because up to a certain point it is convenient. In bacteriology and in chemical physiology it is more

than this; it is probably necessary, for it affords the simplest possible conceptual scheme useful for certain purposes. Its usefulness is like that of Boyle's law for gases—volume varies inversely as pressure—which is true only approximately and only with important restrictions.

Indeed, nothing is more convenient than to be able to think of a phenomenon as simple, of its cause as single, and to feel that, accordingly, there is but one clear, straight path to be followed in action. This is just the kind of situation that satisfies men of action, who are fortunately numerous among doctors, and there is nothing about the growth of medicine in recent years that is more important or that has, upon the whole, contributed more to the relief of suffering and the cure of sickness than the increase in the number of pathological conditions, complex though they are in reality, that may be regarded as mere cases of a particular disease caused by a single cause and curable by the use of a single remedy. Perhaps nothing in modern medicine would have seemed so strange as this to Hippocrates.

The disposition to think in this manner has also been strengthened both by the influence of the conditions of modern life upon the practice of medicine and by increasing specialization. So it comes about that sick people are often regarded as cases rather than persons, and many things in the history of their sickness, many others concerning their environment, which were familiar to general practitioners of an earlier day, are likely to be overlooked and not even suspected. And yet disregard of such factors or of others that seem unimportant in the light of oversimplified theory leads to disaster. The disregarded factors are perhaps as often as not among those which the old-fashioned general practitioner intuitively recognized and which can sometimes be discovered only through intimate acquaintance with the patient and familiarity with his environment, with his life day-by-day, and with his family history.

There are signs of a growing interest in such considerations and of a corresponding realization that successful medical practice must take account of the patient as a person. One reason for this is not obscure, for the practice of medicine is action under the burden of responsibility, of partial responsibility for the outcome of a sickness and complete responsibility for the results of treatment. In the long run responsibility for decision and action is likely to cure the errors of oversimplified thinking, for, as Bacon said, sciences are judged by their fruits, and in medical practice the outcome of treatment is no less a test of the doctor's use of his conceptual scheme, and in the end of that scheme itself, than is the outcome of a laboratory experiment a test of the theory of the experiment.

Theories that will not work must be modified or abandoned. If they are constantly tested and will not work, sooner or later this will happen. But untested theorizing may continue indefinitely.

The facts of pathology and bacteriology, the specific procedures that have been discovered in the treatment of infectious diseases, in nutritional disturbances and in conditions associated with disturbances in the balance of hormones have given rise to theories that seem to be too well established to be overthrown. And yet we shall do well to remember the development of modern physics. For the diagnosis, prognosis and treatment of many cases, at all events, such theories are sufficient. Since they are thus successful, it seems probable that when they fail it is owing to disregard of factors neglected in the theories. In like manner Boyle's law successfully describes the behavior of a gas when temperature remains constant, but fails when temperature varies widely.

In sum, by the process of trial and error, the practice of medicine slowly eliminates fallacies of misplaced concreteness. There is perhaps no sphere of activity in which this elimination is going on more continuously and more effectively, for here theory on a grand scale and a great accumulation of systematic descriptive knowledge are at the foundation of thinking, which is therefore explicit. The thinking, however, is nearly always modified by intuitive familiarity born of experience and by at least a vague sense of the dangers of elaborate deductive reasoning. Among the best physicians it is therefore cautious. But, above all, the doctor's thinking issues in decision, and decision in action. Thus the thinking is continuously put to the test of observation and experiment.

One thing is lacking that would greatly contribute to the efficacy of this elimination of the fallacy, namely, a thorough understanding of the logical nature of the fallacy and easy familiarity with the complexity of the usual mathematical interrelations among many interdependent factors. For the interdependence of many variables can only be treated mathematically. Accordingly, acquaintance with this interdependence and familiarity with it are neither more nor less than acquaintance with and familiarity with the properties of certain kinds of mathematical operations in certain kinds of mathematical systems. But it is almost never possible—one might say it is never possible—to formulate clinical reasoning in mathematical terms. Therefore the doctor, lacking a certain logical discipline through inexperience of mathematical practice, can not clearly conceive the intricacy of the problems that confront him, for here, as everywhere else, practice is necessary to understanding.

So much for the present state of scientific medicine,

of which the merits and defects seem to be fairly plain—at least in those aspects which concern us here.

The social sciences are very different from the medical sciences. Their development has been different; their present state is different. The habits, the attitudes, the procedures of social scientists are, in general, very different from those of medical scientists. And to-day the applications of medical science are innumerable, while it is hard to find effective applications of social science. Let us consider the two groups of sciences comparatively.

Near the end of the "Nicomachean Ethics,"<sup>5</sup> Aristotle prepares the way for his transition to the study of politics with the following remarks:

Must we not, then, next examine whence or how one can learn how to legislate? Is it, as in all other cases, from statesmen? Certainly it was thought to be a part of statesmanship. Or is a difference apparent between statesmanship and the other sciences and arts? In the others the same people are found offering to teach the arts and practising them, *e.g.*, doctors, or painters; but while the sophists profess to teach politics, it is practised not by any of them but by the politicians, who would seem to do so by dint of a certain skill and experience rather than of thought; . . . experience seems to contribute not a little; else they could not have become politicians by familiarity with politics; and so it seems that those who aim at knowing about the art of politics need experience as well.

But those of the sophists who profess the art seem to be very far from teaching it. For, to put the matter generally, they do not even know what kind of thing it is nor what kinds of things it is about; . . . For while people experienced in any department judge rightly the works produced in it, and understand by what means or how they are achieved, and what harmonizes with what, the inexperienced must be content if they do not fail to see whether the work has been well or ill made. . . .

Elsewhere Aristotle says,<sup>6</sup> ". . . people who have spent their lives observing nature are best qualified to make hypotheses as to the principles that bring great numbers of facts together."

Aristotle's criticism may still be made, more than two thousand years after, of much of our current social science, and his explanation of the grounds for his criticism may still be given. In their work social scientists rarely combine theory and practice, and still more rarely work hard, persistently, intelligently, responsibly, unremittingly on the phenomena, in direct, intimate relations with the men and things they study. Accordingly, they commonly lack intimate, habitual, intuitive familiarity with the objects of their investigation.

<sup>5</sup> Book X, from "The Works of Aristotle," ed. by W. D. Ross, The Clarendon Press, Oxford, 1925, Vol. IX.

<sup>6</sup> "De generatione et corruptione," I, 2, 10.

In the social sciences special methods and special skills are few. It is hard to think of anything that corresponds to a mathematician's skill in performing mathematical operations or to a bacteriologist's skill in cultivating microorganisms or to a clinician's skill in making physical examinations. Even in conducting an interview, skill is to be sought among physicians, or certain lawyers, rather than among the generality of social scientists.

Classificatory descriptive knowledge, which is so conspicuous in the medical sciences and in natural history and which has proved so essential to the development of such sciences, is relatively lacking in the social sciences. The most serious effort in this direction with which I am acquainted is Pareto's taxonomic study of the residues, that is, of the manifestations of sentiments. Successful and important as this is, it is but the beginning of a vast and difficult undertaking. Moreover, there is no common accord among social scientists concerning the classes and subclasses of the things they study, and there is even much disagreement about nomenclature.

The theories of the social sciences seem to be in a curious state. One body of theory, that of economics, is highly developed, has been cast in mathematical form and has reached a stage that is thought to be in some respects definitive. This theory, like those of the natural sciences, is the result of the concerted efforts of a great number of investigators and has evolved in a manner altogether similar to the evolution of certain theories in the natural sciences. But it is hardly applicable to concrete reality. As Marshall has said:<sup>7</sup> "There is . . . no scope in economics for long chains of deductive reasoning; that is for chains in which each link is supported, wholly or mainly, by that which went before, and without obtaining further support and guidance from observation and the direct study of real life." Pareto goes quite as far in condemning the applications of economic theory.

The reasons why economic theory is so difficultly applicable to concrete events are that it is an abstraction from an immensely complex reality and that reasoning from theory to practice is here nearly always vitiated by the fallacy of misplaced concreteness. Such application suggests the analogy of applying Galileo's law of falling bodies to the motion of a falling leaf in a stiff breeze. Experience teaches that under such circumstances it is altogether unsafe to take more than a single step in deductive reasoning without verifying the conclusions by observation or experiment. Nevertheless, many economists, some cautiously and others less cautiously, are in the habit of expressing opinions deduced from theoretical con-

siderations concerning economic practice. There is here a striking contrast with medicine, where it is almost unknown for a theorist inexperienced in practice to prescribe the treatment of a patient, and where it is well understood that apprenticeship in a hospital is the only effective preparation for practice.

In other fields of social science theories are generally not held in common by all investigators, but, like philosophical systems, tend to be sectarian beliefs. This is true even in psychology, where the conflicts of physiological psychologists, behaviorists, Gestaltists, psychoanalysts and others sometimes almost suggest theological controversy.

Further, it should be noted that social scientists often seek something else rather than convenience in the construction of their theories. Consider, for example, the following remarks of Durkheim:<sup>8</sup>

A concept is an essentially impersonal representation; it is through it that human intelligences communicate.

The nature of the concept, thus defined, bespeaks its origin. If it is common to all, it is the work of the community. Since it bears the mark of no particular mind, it is clear that it was elaborated by a unique intelligence, where all others meet each other, and after a fashion, come to nourish themselves. . . .

The collective consciousness is the highest form of the psychic life, since it is the consciousness of the consciousnesses. Being placed outside of and above individual and local contingencies, it sees things only in their permanent and essential aspects, which it crystallizes into communicable ideas.

And now note that we are well acquainted with a great number of essentially impersonal representations, such as acceleration in dynamics, entropy in thermodynamics or natural selection in biology, that we well know to have originated with a particular person or persons. Whatever his motive, Durkheim is endeavoring to set up a hypothetical entity that can only cause inconvenience in work because, so far as we know, consciousness is a function of, or is associated with, individual nervous systems. Long ago the biologist Le Dantec said of the Ehrlich school of immunity that when they discovered a new phenomenon they invented a *phenoménisme* to explain it. And very much longer ago William of Occam stated the precept known as Occam's razor: "*Entia non sunt multiplicanda praeter necessitatem*," which is to say that our conceptual schemes should contain no more than the necessary elements.

On the whole, it seems fair to say that the social sciences in general are not cultivated by persons possessing intuitive familiarity, highly developed, sys-

<sup>7</sup> "Elements of Economics of Industry," Macmillan, London, 1905, p. 397

<sup>8</sup> Selections adapted from "The Elementary Forms of Religious Life," pp. 432-37, in R. E. Park and E. W. Burgess, "Introduction to the Science of Sociology," University of Chicago Press, 1921, pp. 194-96.

tematic, descriptive knowledge, and the kind of theories that are to be found in the natural sciences.

There is not a little system-building in the social sciences but, with the striking exception of economic theory, it is of the philosophical type rather than of the scientific type, being chiefly concerned in its structural elements with words rather than with things or, in old-fashioned parlance, with *noumena* rather than with *phenomena*. This involves what I have already described as thinking, talking and writing about vague or general ideas or "concepts" which do not clearly relate to concrete observations and experiences.

For scientific purposes, or for clear thinking of any kind, experience shows that such things will not serve. In support of this assertion I venture to appeal to the late Justice Oliver Wendell Holmes, who once remarked:<sup>9</sup> "I have said to my brethren many times that I hate justice, which means that I know if a man begins to talk about that, for one reason or another he is shirking thinking in legal terms." I shall presume to make a single exegetical remark on Holmes's text: the phrase "shirking thinking in legal terms" may be generalized to read "shirking thinking in terms that can be used for even rough and ready logical purposes or for any sort of clear thinking."

I believe it not unfair to take as an illustration of what is here in question Reinach's definition of religion:<sup>10</sup> "An ensemble of scruples which impede the free exercise of our faculties." After stating this definition, Reinach at once goes on to remark: "This minimum definition is big with consequences, for it eliminates from the fundamental concept of religion, God, spiritual beings, the infinite, in a word, all we are accustomed to consider the true objects of religious sentiment." He has previously pointed out that definitions of religion are many and diverse and that they have not been found convenient in scientific work. The general confusion that has ensued from their use might well suggest the inference that to set up definitions of such a word, at all events without taking very unusual precautions, is inexpedient. Reinach's definition, like most definitions of religion, is a more or less precise designation of attributes of some religions; in other words, the statement of what the author believes or wishes to believe a satisfactory *differentia*. Reinach's remark about the consequences of his definition is almost comic. What are the possible consequences of adopting a definition? Assuredly, no definition can modify the phenomena or the relations between the phenomena. On the other hand,

it can and ordinarily does modify the behavior of the person who accepts it, and Reinach naively admits as much by noting that certain things are eliminated from the fundamental concept of religion. Now, what he eliminates in the beginning will, unless he blunders, not be found in his final conclusion.

Why does Reinach speak of "scruples which impede," and not of needs which further "the free exercise of our faculties"? He is evidently referring to phenomena which arise, at least in part, from systems of conditioned reflexes, and his restriction in pejorative. We know that hostility to contemporary religions was common in Parisians of his class at the time when he wrote "Orpheus." It is therefore not unlikely that such hostility partly explains the defects, from the scientific point of view, of his definition.

A further difference between most system-building in the social sciences and systems of thought and classification of the natural sciences is to be seen in their evolution. In the natural sciences both theories and descriptive systems grow by adaptation to the increasing knowledge and experience of the scientists. In the social sciences systems often issue fully formed from the mind of one man. Then they may be much discussed if they attract attention, but progressive adaptive modification as a result of the concerted efforts of great numbers of men is rare. Such systems are in no proper sense *working* hypotheses, they are "rationalizations." Or at best they are mixtures of working hypotheses and "rationalizations."

Thinking in the social sciences suffers, I believe, chiefly from two defects: one is the fallacy of misplaced concreteness, the other the intrusion of sentiments—of Bacon's Idols—into the thinking, which may be fairly regarded as an occupational hazard of the social scientists. There can be little doubt that this intrusion is one of the factors that make the quotations just cited from Durkheim and Reinach unacceptable as science. Let us consider one more example.

Macaulay says:<sup>11</sup> "[The errors in the works of Machiavelli] arise, for the most part, from a single defect which appears to us to pervade his whole system. . . . The great principle, that societies and laws exist only for the purpose of increasing the sum of private happiness, is not recognized with sufficient clearness." What is the source of this great principle? Evidently it is not an induction from experience. What is the meaning of purpose as applied to the existence of societies? From a scientific point of view, purpose must be somebody's purpose. Like consciousness, it is associated with individual nervous systems. How can the sum of private happiness be measured? Assuredly not with any instruments or by

<sup>9</sup> "Justice Oliver Wendell Holmes: His Book Notices and Uncollected Letters and Papers." Edited by Harry C. Shriver, New York, 1936, p. 301.

<sup>10</sup> "Orpheus, A History of Religions," Horace Liveright, New York, 1930, Introduction, p. 2.

<sup>11</sup> Essay on "Machiavelli."

any procedures that were at the disposal of Macaulay. Is it not evident that Macaulay's "great principle" and his "purpose" of the existence of societies are both expressions of his sentiments, and that "the sum of private happiness" is, in the sense of the logic of modern science, a meaningless phrase? Finally, what is the probability that if Macaulay were writing his essay on Machiavelli in September, 1940, he would feel disposed to make similar assertions? The sentiments, like most other things, vary with time.

Sentiments have no place in clear thinking, but the manifestations of sentiments are among the most important things with which the social sciences are concerned. For example, the word "justice" is out of place in pleading before the Supreme Court of the United States, but the sentiments associated with that word and often expressed by it are probably quite as important as the laws of our country, not to mention the procedure of the Supreme Court. Indeed, such sentiments seem to be in many ways and at many times the most important of all social forces. The still dominant European intellectual tradition treats such things as if they had their origin in the logical thinking of those who manifest them. Yet the sentiments arise and manifest themselves in a manner that is hardly more appropriate for such treatment than is the manner in which the instincts and the passions manifest themselves.

The attribute "justice" is by men variously ascribed to various actions. This ascription varies with time, with place, with age, with sex, with social status, with purpose, with economic interests, with emotional excitement and with innumerable other factors. For the word "justice" is the expression of an attitude. In general, it is irrelevant to inquire whether an assertion which is the expression of an attitude is logically and objectively true or false.

Such attitudes and sentiments are closely related to conditioned reflexes and in part arise from the process of conditioning. This may be illustrated by considering the contrast between the meanings of such pairs of words as house and home, woman and mother, man and comrade, acquaintance and friend or enemy.

The acquired characters of men may be divided into two classes. One kind involves much use of reason, logic, the intellect; for example, the ordinary studies of school and university. The other kind involves little intellectual activity and arises chiefly from conditioning, from rituals and from routines; for example, skills, attitudes and acquired sentiments. In modified form, men share such acquired characters with dogs and other animals. When not misinterpreted, they have been almost completely neglected by intellectuals and are frequently overlooked by social

scientists. In their study a great opportunity seems to present itself for the application of physiology.

The conclusions of this comparative study are as follows: First, a combination of intimate, habitual, intuitive familiarity with things; systematic knowledge of things; and an effective way of thinking about things is common among medical scientists, rare among social scientists. Secondly, systems in the medical sciences and systems in the social sciences are commonly different. The former resemble systems in the other natural sciences, the latter resemble philosophical systems. Thirdly, many of the terms employed currently in the social sciences are of a kind that is excluded, except by inadvertence, from the medical sciences. Fourthly, sentiments do not ordinarily intrude in the thinking of medical scientists; they do ordinarily intrude in the thinking of social scientists. Fifthly, the medical sciences have made some progress in the objective study of the manifestations of sentiments; the social sciences, where these things are particularly important, have neglected them. This is probably due to the influence of the intellectual tradition. Sixthly, in the medical sciences special methods and special skills are many; in the social sciences, few. Finally, in the medical sciences testing of thought by observation and experiment is continuous. Thus theories and generalizations of all kinds are constantly being corrected, modified and adapted to the phenomena, and fallacies of misplaced concreteness eliminated. In the social sciences there is little of this adaptation and correction through continuous observation and experiment.

These are very general conclusions to which, as I have already said, there are numerous and important exceptions. Perhaps the most important exceptions may be observed in the work of many historians, of purely descriptive writers, and of those theoretical economists who scrupulously abstain from the application of theory to practice.

When we reflect upon these differences between the two kinds of studies of men, shall we not do well to think also of the fruitfulness of the medical sciences and of the unfruitfulness of the social sciences? But let us not try to say what is here cause, what effect. Human interactions are intricate and obscure, and the art of studying them is difficult. That is, we can but feel, a part of the cause of the habits of thought and procedure of social scientists, and of the unfruitfulness of their science as well. Yet, assuredly, there is no simple cause of the present condition. What we can say with some confidence, for it is the lesson of experience, is this: The social sciences will become more fruitful when in certain ways the thought and procedures of social scientists conform more closely to those of medical scientists.

## OBITUARY

## CHARLES LLOYD CONNOR

CHARLES LLOYD CONNOR, M.D., professor of pathology at the University of California Medical School, died from a cerebral hemorrhage, on June 12, at the age of fifty years. After completing his medical education at Baylor University in 1920, Dr. Connor became a fellow of the National Research Council and later was appointed to the pathology staff at Harvard Medical School. In 1926, Dr. Connor acted as director of the pathology laboratory of the Montreal General Hospital. Following his return to Harvard, Dr. Connor was called in 1928 to be professor of pathology at the University of California Medical School, San Francisco. There he notably demonstrated his executive ability in organizing many effective cooperative research projects, in developing a capable staff, and in promoting an exceptional teaching and research museum. Dr. Connor's contributions to medical science include pioneer studies in Rocky Mountain Spotted Fever; the nature of normal and abnormal pigments in the body; malignant tumors, particularly those arising in bone, and more recently he has made fundamental studies regarding the pathogenesis of cirrhosis of the liver. His conclusion is now widely accepted that high fat intake with resulting prolonged fatty infiltration tends toward cirrhosis, especially in diabetes or in chemical injury, as in chronic alcoholism.

A memorial fund is being raised by his colleagues and students at the University of California Medical

School as an expression of regard for his unselfish spirit and for generous efforts in the activities of the Medical School.  
C. L.

## RECENT DEATHS

DR. WILLIAM HENRY BURNHAM, since 1936 professor emeritus of education and school hygiene at Clark University, with which he had been connected for thirty-five years, died on June 25 at the age of eighty-five years.

DR. VINNIE ARAH PEASE, since 1920 micro-analyst in the Bureau of Chemistry (now the Bureau of Agricultural Chemistry and Engineering), died on April 30 in her sixtieth year.

DR. LEE ELLIS MILES, for thirteen years plant pathologist for the Mississippi Experiment Station, died on May 11 at the age of fifty-one years.

DR. J. W. C. GUNN, professor of pharmacology and dean of the faculty of medicine of the University of Capetown, died on May 4 at the age of fifty-two years.

ALEXANDRE ARSÈNE GIRAULT died in the hospital in Brisbane on May 2. He was born at Annapolis, Md., U. S. A., in 1884, and was the author of numerous papers on Chalcidoidea. He was associated with the U. S. Bureau of Entomology and the University of Illinois. For many years he lived in Queensland, where he did entomological work for the Department of Agriculture and Stock.

## SCIENTIFIC EVENTS

RETIREMENT OF HERBERT P. WHITLOCK  
OF THE AMERICAN MUSEUM OF  
NATURAL HISTORY

HERBERT P. WHITLOCK, who for the past twenty-five years has been curator of natural history of the Department of Minerals and Gems in the American Museum of Natural History, retired as head of the department on July 1, but he will continue to give his interest and support as curator emeritus and research associate in jade.

At a recent meeting of the executive committee of the board of trustees the following resolution was passed:

That the trustees learn with deep regret that Herbert P. Whitlock desires to resign as curator of the Department of Geology and Mineralogy, which he has served so loyally and so efficiently since his appointment on June 3, 1918. The museum is justly proud of its magnificent collection of gems and minerals which has been so greatly augmented by the untiring efforts and vigilance of Mr. Whitlock. In recognition of his faithful performance of

his duties as curator and his unremitting interest in building up the museum's world-famous collections in his field, the trustees take pleasure in hereby appointing Mr. Whitlock *Curator Emeritus* of the Department of Geology and Mineralogy and *Research Associate in Jade*—these appointments to be effective as of July 1, 1941.

In making known the action of the Board of Trustees, Dr. Roy Chapman Andrews, director of the American Museum, said:

This will serve to notify his many friends that Mr. Whitlock's office will remain open to all those who seek his advice. Mr. Whitlock has long been known affectionately as "The Keeper of the Gems" in the museum, and there has never been a day that has passed but that from ten to twenty visitors beat a path to his office to ask the identification of some mineral specimen, the examination of a gem, or the story and symbolism of a piece of carved jade.

According to Mr. Whitlock's philosophy as to the work of a museum curator he has always demonstrated his belief that his time and efforts belong to the people of the

community and once remarked to me: "I believe that a modern well-equipped museum ranks among the greatest influences for culture, enlightenment and spiritual uplift in any community; because here, as with great music, writing and painting, men of vision may pass on their vision to their fellow men and to posterity. I believe that the language that a museum worker should be able to speak is the language of little children."

Mr. Whitlock has even taken the study of minerals and gems to the classrooms of New York City schools and colleges by means of special illustrated talks. His annual fall and spring series of lectures on jade and jade carving in the museum have made hundreds of enthusiasts for this beautiful gem stone. We are happy to announce that Mr. Whitlock will continue these talks in the future.

Under his leadership the collection of precious and semi-precious gems has increased from 2,060 to 2,562 exhibits, with many world-famous gems such as the magnificent De Long Star Ruby, the Schettler Emerald and the Morgenthau Topaz. The mineral collection has grown from 18,452 to 21,293, including many rare minerals discovered in recent years. Among the most recent additions is the mineral Whitlockite, a tricalcium phosphate discovered by Clifford Frondel and named in honor of Mr. Whitlock. All these specimens, selected with care after detailed scrutiny, have made the greatest single collection of minerals and gems on this side of the Atlantic. Outstanding among the exhibits is the magnificent Drummond Jade Collection, one of the most complete in the world, obtained through the efforts of Mr. Whitlock.

By action of the Board of Trustees, Dr. Frederick H. Pough, formerly assistant curator of geology and mineralogy, becomes, upon the retirement of Mr. Whitlock, acting curator of the Department of Minerals and Gems.

#### THE BOTANICAL EXPEDITION TO GUATEMALA OF THE FIELD MUSEUM

PAUL C. STANDLEY, curator of the herbarium of the Field Museum of Natural History, has returned to Chicago after an expedition of seven and a half months, during which he collected in almost all parts of Guatemala. He brought back approximately 30,000 specimens of plants for addition to the herbarium.

These plants and others collected on two previous expeditions conducted by Mr. Standley and Dr. Julian A. Steyermark, assistant curator of the herbarium, will be used in a research upon which will be based the preparation of the first complete flora of Guatemala to be published.

Mr. Standley reported that Guatemala is ably assisting in combating the problem of a possible shortage of supplies of the important drug quinine which might become unavailable from its present principal source, the Dutch East Indies, in the event of unfavorable developments in the international situation. He stated

that quinine plantations, operated in Guatemala by United States capital, have been expanded rapidly and successfully, and will be able to produce a supply of the best grade of quinine adequate for a large part of American medicinal and industrial demands. In addition, Guatemala is operating the only commercial tea plantations outside the Orient.

Many species of plants hitherto unknown to science are included in the collections for the museum, and records were obtained of the growth of many plants known elsewhere but not previously found in Central America. The vegetation of the country is varied, ranging from plants of subarctic to tropical climate and from plants of the mountains to those of the plains. They include a wide variety of orchids.

#### THE HIGH SCHOOL OF SCIENCE IN NEW YORK CITY

THE first commencement of the High School of Science in New York City was held on June 28. Dr. Otis W. Caldwell, general secretary of the American Association for the Advancement of Science, and Dr. Thomas H. Briggs, of Teachers College, Columbia University, and others cooperated with Associate Superintendent Frederic Ernst in the establishment of the school last autumn, and Dr. Maurice Meister was appointed head master. Dr. Irving Langmuir, president of the American Association for the Advancement of Science, who was expected to make the principal address, was unable on account of illness to be present.

The school is housed in a building originally designed for an academic high school of a different type. In order to provide the special facilities needed for science study, the physical plant was revamped from cellar to roof. A WPA project costing more than half a million dollars is now nearing completion. Every feature of this project was planned by the faculty and arose out of the needs of the students and of the curriculum. The school now boasts of eight modern laboratories, ten preparation and store rooms, three fully equipped shops and twelve special science recitation rooms. In addition, there is a visual instruction lecture room, a large library, an English workshop, a voice recording studio, four mechanical drafting rooms, a graphic arts shop, a music room, a gymnasium and a swimming pool. The auditorium platform is equipped with a movable demonstration table which makes possible the presentation of science experiments to large audiences. The Board of Education has supplied the necessary, up-to-date equipment, books and materials. Next autumn, when the renovation project is completed, the High School of Science will enjoy the most unique physical plant in the country for the teaching of science to high-school boys.

## THE OLIN HALL OF CHEMICAL ENGINEERING AT CORNELL UNIVERSITY

THE cornerstone of the Olin Hall of Chemical Engineering of Cornell University, to be erected at a cost of \$700,000, was laid on June 14, during the annual alumni reunions. In the absence on account of ill health of Franklin W. Olin, the donor, the ceremony was performed by his son, John M. Olin, who made a brief address. Another son, Spencer T. Olin, was also in attendance.

President Edmund Ezra Day in his reply said:

We have had a dream of the future of engineering at Cornell. It is a dream set in an illustrious record of achievement in the past in this field. It has to be remembered that it was at Cornell University that engineering was first recognized as worthy of support by the full resources of a great educational institution and first achieved distinction at the university level. It is unbelievable that engineering at Cornell should cease to have a place of great distinction in American education, but it has been clear at the same time that if that place were to be here, the existing resources of the Engineering College here at Ithaca had to be promptly and substantially amplified. Consequently, we have been dreaming dreams. For a time they seemed to be but dreams. Then Franklin W. Olin stepped into the picture and gave us reassurance of immeasurable value. Sometimes benefactions have values which defy measurement. It is my opinion that this great gift of Mr. Olin falls in that class. Not only does it supply the need of modernized facilities for the School of Chemical Engineering; it gives reassurance of the success of the whole Engineering College program. The value of this gift is enhanced because of its timing. It comes at a time when this undertaking needed just the kind of "lift" that this edifice gives. Nothing that has happened at Cornell since I have been here has afforded so much encouragement for the future.

Dean S. C. Hollister, of the College of Engineering, who presided at the ceremony, then introduced Spencer T. Olin, who briefly substantiated the sentiments expressed by his brother; Ezra Whitman, chairman of the Trustee Committee on Buildings and Grounds; Provost H. W. Peters; Maxwell M. Upson, chairman of the Committee on Development of the Endowed Colleges of the Board of Trustees; John Lowry, of John Lowry, Inc., contractor of the building; Harold Shreve, of Shreve, Lamb and Harmon, architects of the building, and Dr. F. H. Rhodes, Johnson professor of industrial chemistry and director of the School of Chemical Engineering. It is planned to open the new building in the autumn.

## THE PUBLIC HEALTH RESEARCH INSTITUTE OF NEW YORK CITY

AN appropriation of \$100,000 is included in the 1941-42 budget of the Health Department for the new Public Health Research Institute of New York

City. It will be used exclusively for scientific research essential for the protection and the improvement of the health, safety and welfare of the people of the city.

Following favorable action by the Board of Estimate and the City Council, the Board of Estimate on June 26 authorized the city to enter into a contract with the Research Institute. This will be a scientific, non-profit organization, entirely devoted to obtaining for the city the best available biological products and advanced skill and procedures for combating disease and epidemics which occur or may occur.

In commenting on the Board of Estimate's approval of the contract, Mayor F. H. LaGuardia said:

Many public health problems that arise in this city are peculiar to this locality, and scientific research and experimentation with regard thereto must be done locally. In this the largest city in the world, disease may readily assume epidemic proportions and thus it is most essential that our municipal Health Department be fortified with the best research talent and facilities available. The Research Institute will make that possible.

Dr. John L. Rice stated that David M. Heyman, a member of the banking firm of Adolph Lewisohn and Sons, had been named president of the institute and a member of the Board of Health. The *President* of the Board of Health is David Rockefeller, son of John D. Rockefeller, Jr.; the *Vice-president*, David Morse, attorney; the *Secretary and Treasurer*, Edwin P. Chinlund, president of the Postal Telegraph Company. *Ex-officio* members of the board are: Mayor LaGuardia, Comptroller Joseph D. McGoldrick and the Health Commissioner.

A research council has been set up by the board, with Dr. Thomas M. Rivers, director of the Hospital of the Rockefeller Institute for Medical Research, as *chairman*. Dr. Rivers also is a member of the Board of Health of New York City. Other medical and scientific men named to the Research Council are:

Dr. Eugene L. Opie, professor of pathology, Cornell University Medical College; Dr. Henry Clapp Sherman, professor of chemistry, Columbia University; Dr. Michael Heidelberger, associate professor of biochemistry of the College of Physicians and Surgeons, Columbia; Dr. George Baehr, clinical professor of medicine of the College of Physicians and Surgeons, who is also physician to Mount Sinai Hospital, trustee of the New York Academy of Medicine and chairman of its Public Health Relations Committee, and Dr. Ralph S. Muckenfuss, director of the Bureau of Laboratories of the Department of Health, member *ex-officio*.

The contract between the city and the Research Institute, approved by the Board of Estimate, became effective on July 1. Neither members of the Board of Directors nor of the Research Council will receive

salaries, the province of the former being to assure sound business management and of the latter to retain the necessary scientific personnel. The institute will be housed in the William Hallock Park Laboratory in the Bureau of Laboratories of the Health Department.

#### MEETING OF THE INTERNATIONAL COLLEGE OF SURGEONS IN MEXICO CITY

ON the invitation of the Mexican Government the International College of Surgeons will hold its fourth international assembly in Mexico City from August 10 to 14.

Surgeons from most of the countries of the western hemisphere and also from England, Holland, Palestine, Portugal, Switzerland and Turkey will participate. Many of the Pan-American countries are sending official representatives. Sessions will be conducted in both English and Spanish.

More than one hundred and twenty speakers will

describe the latest advances in surgery of their particular countries. Especially emphasized will be military surgery, and the lessons learned from the Spanish civil war, current British campaigns and civilian experiences during air raids. There will also be numerous exhibits of recent surgical research, operative clinics at many hospitals and demonstrations by leading manufacturers of newly developed equipment. Headquarters are at the Hotel Reforma.

Among the lecturers will be Dr. Francisco Castillo Najera, Mexican Ambassador to the United States; Dr. Fred H. Albee, New York, international president of the college; Dr. Manuel A. Manzanilla, Mexico City, president of the Mexican Committee of Organization; Dr. Desiderio Roman, Philadelphia, president of the United States Chapter, and Dr. Max Thorek, Chicago, international secretary.

The International College of Surgeons was founded at Geneva, Switzerland, in 1935, and has chapters in most of the nations of the world.

## SCIENTIFIC NOTES AND NEWS

THE autumn meeting of the National Academy of Sciences will be held at the University of Wisconsin on October 13, 14 and 15. This is the first meeting of the academy to be held west of Chicago since 1925. The address of welcome will be made by Dr. Clarence A. Dykstra, president of the university, to which Dr. Frank B. Jewett, president of the academy, will respond.

THE Ward Burdick Gold Medal, presented annually by the American Society of Clinical Pathologists for an "outstanding contribution in the field of pathology," has been awarded to Dr. Harry P. Smith, of the University of Iowa, in recognition of his work on vitamin K as a blood-clotting agent.

THE Society for the Promotion of Engineering Education has awarded the Lamme Medal for 1941 to Dr. Anson Marston, dean emeritus and for fifty years a member of the faculty of the Iowa State College of Agriculture and Mechanical Arts at Ames. The award is the fourteenth made by the society for achievement in engineering education in memory of Benjamin G. Lamme, a pioneer in the engineering development of electric power.

THE Council of the London Mathematical Society has awarded the De Morgan Medal to Professor Louis Joel Mordell, of the University of Manchester.

AT the anniversary meeting of the Linnean Society of London, its Gold Medal was presented to Professor A. G. Tansley, emeritus professor of botany in the University of Oxford, in recognition of his contribu-

tions to ecology, and particularly to the development of the subject in Great Britain. The medal is awarded annually to "an eminent biologist as an expression of the society's estimate of his services to science." The Carnegie Corporation of the United States has recently granted to the society the sum of £2,000 for the purpose of photographing the manuscripts and natural history specimens in the collections of Linnaeus. The following have been elected officers of the society: *President*, Dr. E. S. Russell; *Treasurer*, Major F. C. Stern; *Secretaries*, I. H. Burkill (botany), and Dr. Malcolm Smith (zoology); *New Members of the Council*, Dr. B. Barnes, Professor F. T. Brooks, J. E. Dandy, A. C. Gardiner and Douglas M. Reid.

THE Council of the Royal Society of New South Wales has awarded the Clarke Memorial Medal to Professor F. Wood-Jones, now professor of anatomy at the University of Manchester, in recognition of his researches in zoology in Australia.

DR. CARL J. WIGGERS, professor of physiology of the School of Medicine of Western Reserve University, was awarded the honorary degree of doctor of science by the University of Michigan at its commencement exercises on June 21.

MICHIGAN STATE COLLEGE, at its eighty-third annual commencement on June 14, conferred the honorary degree of doctor of agriculture upon John A. Hannah, president-elect of the college, and on Howard E. Babcock, president of the Board of Trustees of Cornell University, and, as recorded in the last

issue of *SCIENCE*, the degree of doctor of science upon Truman G. Yuncker, professor of botany at DePauw University.

At the fiftieth annual commencement exercises on May 30 of Buena Vista College, Storm Lake, Iowa, the honorary degree of doctor of science was conferred on Dr. Stanley B. Fracker, in charge of the Division of Plant Disease Control of the Bureau of Entomology and Plant Quarantine of the U. S. Department of Agriculture. Dr. Fracker gave the commencement address, which was entitled "Retreating Frontiers."

DR. ERNEST SACHS, professor of neurological surgery at Washington University, St. Louis, has been elected an honorary member of the Royal Society of Medicine.

HOMER J. HENNEY, chief of the program planning division of the Federal Crop Insurance Corporation of the U. S. Department of Agriculture, has been appointed dean of agriculture at Colorado College and director of the Experiment Station.

At the New York Medical College, Dr. J. A. W. Hetrick, head of the department of otolaryngology and associate dean, has been appointed acting dean following the death of Dean Claude Adelbert Burrett. The separate departments of histology, embryology, neuroanatomy and gross anatomy have been merged in one department of anatomy under the chairmanship of Dr. C. E. Tharaldsen. The department will be known as the William Waldo Blackman Department of Anatomy. Dr. L. Corsan Reid has been transferred from the department of pathology to the department of physiology; Dr. Stephen P. Jewett has been appointed head of the newly established department of psychiatry, and Dr. Thomas I. Hoen, head of the department of neurology and neurosurgery. Dr. Joseph H. Fobes has become head of graduate surgery, and Dr. Louis René Kaufman, of undergraduate surgery. Dr. Reuel Allen Benson has been appointed Helen S. Case professor of pediatrics.

DR. J. N. GOODIER, head of the department of mechanics of the Sibley School of Mechanical Engineering of Cornell University, has been appointed head of the department of mechanics in the School of Civil Engineering. He will proceed with plans to correlate instruction in mechanics in the two schools of the College of Engineering.

DR. ARTHUR C. COPE, of Bryn Mawr College, has been appointed associate professor of chemistry at Columbia University.

THE announcement of the new appointment of Dr. Eugene F. DuBois at the Cornell University Medical

College, in the last issue of *SCIENCE*, should have read "professor and head of the department of physiology and biophysics."

THE retirement from active service is announced of Dr. William H. Kenerson, professor of mechanical engineering, chairman of the division of engineering of Brown University, who has been a member of the faculty for forty-five years.

ACCORDING to *Nature*, Dr. W. G. Woolnough, geological adviser to the Federal Government of Australia, has retired from the Commonwealth Public Service after thirteen years service and has been succeeded by Dr. R. W. Raggatt, of the Commonwealth Geological Staff.

DR. THEODORE G. KLUMPP has resigned his position as chief of the Drug Division of the Food and Drug Administration to become director of the division of drugs, foods and physical therapy, and secretary of the Council on Pharmacy and Chemistry of the American Medical Association. He succeeds the late Dr. Paul N. Leech.

DR. FRANK T. MCFARLAND, head of the department of botany at the University of Kentucky, has been named first curator of the university herbarium. There are approximately 30,000 plants already in the collection, and about 10,000 still unidentified.

DR. JOHN FRAZER, secretary of the committee on science and arts of the Franklin Institute, Philadelphia, has been elected assistant secretary of the institute.

DR. H. I. CRAMER, professor of rubber chemistry at the University of Akron, Ohio, has resigned to become associated with the Research and Development Department of Sharpless Chemicals, Inc., Philadelphia.

THE William Lowell Putnam Scholarship for 1941 for study at Harvard University has been awarded to Richard F. Arens, of the University of California at Los Angeles.

THE Charles W. Hargitt research fellowship in zoology at Duke University has been awarded for the year 1941-42 to Dr. Dwight L. Ryerson, of the University of California at Los Angeles. Appointment to the fellowship is made annually for post-doctoral research in the field of cytology.

DR. LUDVIG GUSTAV BROWMAN, assistant professor of zoology and physiology at Montana State University, has received a second grant in aid of \$500 from the National Research Council for the continuation of his research on the effect of light on the growth and activity of rats.

ACCORDING to *Museum News* Dr. F. Trubee Davison, president of the American Museum of Natural His-

tory, has been called to active duty in the Army Air Corps.

ACCORDING to the *News Edition* of the American Chemical Society Dr. Cecil G. Dunn, assistant professor of industrial biology in the department of biology and public health of the Massachusetts Institute of Technology, has been ordered to active duty by the War Department. He has been assigned to head the Section on Research and Development, Subsistence Branch, Supply Division, Office of the Quartermaster General, Washington, D. C.

THE American Society for X-Ray and Electron Diffraction, plans for which were announced in *SCIENCE* for May 23, starts its existence with a charter membership of 124. The officers elected for 1941 are: *President*, M. L. Huggins, of the Eastman Kodak Company; *Vice-president*, B. E. Warren, of the Massachusetts Institute of Technology; *Secretary-Treasurer*, George Tunell, of the Geophysical Laboratory, Washington, D. C. The first meeting of the society will be held from July 28 to August 1 at Gibson Island, Md., in cooperation with Section C of the American Association for the Advancement of Science. Reservations for this meeting are in charge of Dr. Neil E. Gordon, Gibson Island, Md.

To meet increasing demands for trained meteorologists, the University of Cincinnati has announced a new four-year undergraduate program in meteorology leading to the B.A. degree, which is believed to be among the first of its kind in the United States. Students will be trained for positions with air lines, at airports and air bases, and with weather bureaus. Both the Army and Navy are reported to be facing a shortage of specialists in meteorology, particularly in their air services.

THE Harvard College Observatory will issue this summer a new series of nine popular books covering the principal areas of astronomy, edited by Professor Harlow Shapley and Associate Professor Bart J. Bok. The books will be titled "The Harvard Books on Astronomy," and are written by the Harvard Observatory specialists in the various fields. Five of the

volumes are now in press, and the remaining four will be issued before fall. The volumes will give a complete and simplified presentation of modern scientific knowledge in each of the major fields of astronomy, it was explained. They are designed for adults and secondary school or university students, having acquaintance with the elementary principles of physics. By separating the treatment into nine volumes, of about two hundred pages each, it will be possible to keep the series up to date by issuing new editions of individual volumes.

A COMPLETE replica of the Westinghouse Time Capsule and its contents has been installed as a permanent exhibit at the Hayden Planetarium of the American Museum of Natural History. It was opened to the public at dedication ceremonies on June 17. This 800-pound specially constructed capsule was presented by David S. Youngholm, vice-president of the Westinghouse Electric and Manufacturing Company, and was accepted for the Hayden Planetarium by Professor William H. Barton, Jr., executive curator of that institution.

It is stated in the *London Times* that the herbarium near Hudiksvall, in Sweden, containing 30,000 specimens of preserved roses, compiled and classified by the late Reinhold Matsson, the Swedish churchman and botanist, has been destroyed by fire.

*Nature* writes: "War has again inflicted severe losses on the University of Louvain. Numerous university buildings were destroyed during hostilities, including the library rebuilt by American generosity and restocked by gifts from nearly every university in the world. Of its 900,000 volumes 15,000 only remain intact, and of its 800 manuscripts only 15 are left."

ACCORDING to *The Australian Journal of Science* the Minister of Labor and Industry, Mr. Holt, has arranged that a scientific mission be sent from Australia to Canada, the United States and Great Britain, in order to coordinate technical work in relation to the war, particularly in the fields of physics and engineering.

## DISCUSSION

### ESTABLISHMENT OF A NATURAL AREA ON THE HUNTINGTON WILDLIFE FOREST

ON January 18, 1941, the New York State College of Forestry, through the Executive Committee of the Board of Trustees and upon recommendation of Dean Samuel N. Spring, established a Natural Area of approximately 1,000 acres on the Huntington Wildlife Forest. The Forest, a 15,000 acre tract in the central Adirondacks west of Newcomb, N. Y., is held in trust

for the New York State College of Forestry for "investigation, experiment and research in relation to the habits, life histories, [and] methods of propagation and management of fish, birds, . . . and . . . mammals . . ." and is administered by the Roosevelt Wildlife Forest Experiment Station under the direction of E. T. King. The Natural Area, a typical sample of the spruce-northern hardwoods vegetation in the Adirondack region (lower Canadian Zone of Merriam), is a

triangular tract which lies in the northwest part of the Forest, bounded on the southeast by the three-mile long Catlin Lake. It is covered largely by old growth, but not virgin, spruce-northern hardwoods, together with upper spruce slopes, spruce flats and typical lake-shore and lowland vegetation. Several clearings remain from an original settlement.

Appreciation for the role of the Natural Area in land management research is developing rapidly. New possibilities are revealed where multiple land use is designed to supply the highest returns of such renewable resources as timber, wildlife, forage, water and recreational values. New interpretations of the critical controls of vegetation are made possible, not only in terms of the constantly acting and greatly over-emphasized weather and soil, but also of the intermittently acting factors such as fires, hurricanes and epidemic and cyclic population variations. New methods of management are revealed for regions remote or of irregular terrain where the vegetation must be controlled indirectly for conversion to desirable semi-natural types. For such reasons as these, it is of the utmost importance that samples of natural vegetation be preserved or be permitted to develop for study and reference. Increased though still insufficient interest in this subject has been evoked by such statements as those of Shelford,<sup>1</sup> Leopold,<sup>2</sup> Ashe,<sup>3</sup> Pearson,<sup>4</sup> Adams,<sup>5</sup> Shelford,<sup>6</sup> Toumey and Korstian,<sup>7</sup> Hanson,<sup>8</sup> Pienzeisel,<sup>9</sup> Baldwin,<sup>10</sup> and Hough.<sup>11</sup> Due to the work of these men and others, natural areas have been established in many parts of the country, the most outstanding recent ones being the Panama Canal Zone Biological Area in Gatun Lake and the Tionesta Natural Area of 2,100 acres in northwestern Pennsylvania.

Regretfully, because the foresight of our forefathers was not always as well developed as we consider our own to be, many extensive parts of the northeast have been entirely stripped of their original vegetation cover, leaving nothing to indicate what the land had borne and might bear under a dynamic natural equilibrium. Although this is not entirely true of the Adirondacks, where state-owned virgin timber still exists at the higher elevations, protected by the provisions of the New York State Forest Preserve, no tract has come to the attention of the author which

is at elevations comparable to those of the Huntington Forest and satisfactorily located in reference to other experimental lands as to permit a broadly planned research program. For the fulfillment of such a role, the Huntington Forest Natural Area is dedicated to scientific research of natural equilibria and is to be administered with full recognition of the dangers inherent in unwarranted trespass. It is to serve as an outdoor laboratory for studies of wildlife, flora, forests, soil and influences, and is admirably suited for long-time studies of conditions uninfluenced by anthropic factors. It is designed for investigations of the changes concomitant with the attainment of a dynamic equilibrium of flora, soils and weather, as well as fluctuations and variations in response to biologic and climatic cycles and to natural regeneration. Its position in the Huntington Wildlife Forest will permit it to benefit by the proximity of the technical headquarters of a field experiment station and to serve as an integral check area for purposes of comparison both with other and parallel experiments being run under disturbed conditions and with cultural operations throughout this part of the Adirondack Mountains.

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### THE RELATION BETWEEN MENTAL AND PHYSICAL DEVELOPMENT

IN a recent publication<sup>1</sup> Professor Franz Boas discussed the results of a growth study done in the Lincoln School. Emphasis was placed on the unexpectedly high relation between intelligence quotients and indices of physical development, both expressed as deviations from the mean of the age group. The graphs in which stature deviations were plotted against intelligence quotient deviations appear to be based on 22 points for the boys and 17 points for the girls. Assuming that these points represent individuals it is possible to compute coefficients of correlation. These are  $+ .68 \pm .08$  for the boys and  $+ .47 \pm .10$  for the girls. If, however, these points represent averages, the correlations can not be estimated from inspection of the graphs. Measures of variability must also be available.

Professor Boas feels that these results corroborate the inference drawn by him from the work of Porter.<sup>2</sup> Now, Porter's data show only the means without corresponding measures of variability. From the means alone one would conclude that, at a given age, physically accelerated children are in advanced grade loca-

<sup>1</sup> F. B. Sumner, *SCIENCE*, 54 (1885): 39-43, 1921.

<sup>2</sup> A. Leopold, *Jour. For.*, 19: 718-721, 1921.

<sup>3</sup> W. W. Ashe, *Jour. For.*, 20: 276-283, 1922.

<sup>4</sup> G. A. Pearson, *Ecol.*, 3: 284-287, 1922.

<sup>5</sup> C. C. Adams, *N. Y. B. Mus. Bull.* 279: 37-46, 1929.

<sup>6</sup> V. E. Shelford, *Ecol.*, 14: 240-245, 1933.

<sup>7</sup> J. W. Toumey and C. F. Korstian, *Foundations of Silviculture*, p. 3, 1937.

<sup>8</sup> H. C. Hanson, *Sci. Mon.*, 48: 180-146, 1939.

<sup>9</sup> E. L. Pienzeisel, *SCIENCE*, 92(2383): 195-197, 1940.

<sup>10</sup> H. I. Baldwin, *SCIENCE*, 93(2404): 81-82, 1941.

<sup>11</sup> A. F. Hough, *Ecol.*, 22: 85-86, 1941.

<sup>1</sup> F. Boas, *SCIENCE*, n.s., 93: 339, 1940.

<sup>2</sup> W. T. Porter, *Trans. of the Academy of Science of St. Louis*, 6: 161, 1895.

tions. And, conversely, physically retarded children are retarded in grade location. But Porter does present, by way of illustration, the complete data on weight and grade location for 2,169 boys at age 9. A coefficient of correlation based on this portion of his total group is  $+ .06 \pm .01$ .<sup>3</sup> Other studies are, in general, comparable. Correlations between height or weight with measures of intelligence appear regularly in the range  $+ .10$  to  $+ .20$ . Baldwin<sup>4</sup> found a partial correlation, age constant, between height and mental age of  $+ .53$ . But the partial between weight and mental age was  $- .15$  on the same group, although height and weight are in general correlated closely.

The same problem has been attacked through longitudinal studies<sup>5</sup> in which spurts in physical growth are correlated with spurts in mental growth. Whether mental growth is measured by intelligence tests or school achievement seems not to be important. The correlations are in the area  $+ .15$ .

The results cited by Professor Boas are, therefore, not in agreement with previous findings. In view of the lively controversial aspects of this problem the complete presentation of the data referred to by Professor Boas will be awaited with interest.

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## THE SOLAR RADIATION CONSTANT AND THE ACTIVE REGION ON THE SUN

In the April 11, 1941, number of *SCIENCE* Dr. C. G. Abbot, secretary of the Smithsonian Institution, has published a paper on some variations in the solar radiation constant which have not hitherto been described. Some of these variations in the intensity of solar radiations have occurred at successive periods of the solar rotation, indicating that they are, at least temporarily, confined to some geographic region upon the sun.

In a paper entitled "On the Localization of Sun-spots and Floccular Activity on the Sun's Surface" in *Publications of the Astronomical Society of the Pacific*, Vol. 47, 1935, and in *SCIENCE* of October 4, 1940, there was published a paper entitled "The Active Region on the Sun's Surface," in both of which papers attention was called to a permanently active sun-spot region occurring at definite intervals of 27.25 days. This region was shown to have been facing the earth on May 2, 1931, which was the last maximum referred to in the 1935 paper in the *Publications of the Astronomical Society of the Pacific*.

<sup>3</sup> D. G. Paterson, "Physique and Intellect," New York: Appleton-Century, 1930.

<sup>4</sup> B. T. Baldwin and L. I. Stecher, *Univ. of Iowa Studies in Child Welfare*, 2: 56, 1922.

<sup>5</sup> N. Bayley, 39th Yearbook, National Society for the Study of Education, Pt. 2: 49, 1940.

From the several dates to which Dr. Abbot refers as showing radiation irregularities, a few have been selected for comparison with the time at which the maximum-sun-spot region must have crossed the sun's central meridian.

The dates August 18, 19 and 20, 21, 1929, are given. From August 20, 1929, to May 2, 1931, was 620 days, which equal 22 solar rotations of 27.25 days each, lacking seven days of 23 solar rotations.

Another selected date is December 4, 5 and 6, 7, 1929. From December 5, 1929, to May 2, 1931, is 512 days, which equals 18 solar rotations plus 21 days, or 6 or 7 days before the next maximum sun-spot region is facing the earth.

July 7, 8 and 9, 10, 1930, are also referred to. From July 8, 1930, to May 2, 1931, is 298 days, or 10 solar rotations plus 25 days, or two days before the maximum of the next sun-spot region crosses the sun's principal meridian.

January 19, 1931, was 103 days before the disturbed region on the solar surface faced the earth. This was four solar rotations less six days.

The present writer undertook to find a relation between the solar constant and the permanently disturbed region on the sun several years ago, but without success. The limits of this region seem to be very sharply defined. However Abbot's results seem to suggest that the intensity of solar radiation may be related to the solar rotation period, but that its variation occurs a few days before the sun-spot disturbance region is facing the earth.

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## AN ANALYSIS OF THE SPREAD OF EPIDEMICS

IN "Elementi per una teoria matematica del contagio" (Roma 1939, Editoriale aeronautico) Dr. Marcello Poma has developed an "equazione fondamentale,"  $\frac{dx}{dt} = k \cdot x \cdot (n - x)$ , governing the spread of contagion.

I should like to state that in 1938 I published a paper ("Bibliotek for Laeger," November, 1938, Copenhagen), in which the above formula is developed and discussed as giving a possible explanation of epidemic waves. The paper contains some tests of the formula, comparing the courses of actual epidemics with the course described by the formula.

A much enlarged investigation of the theory supported by the analysis of numerous epidemics of different diseases will appear (in English) in "Acta medica scandinavica," Copenhagen.

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## SCIENTIFIC BOOKS

## NATIONAL UNITY AND DISUNITY

*National Unity and Disunity.* By GEORGE KINGSLEY ZIPF. xix + 408 pp. Bloomington, Ind. The Principia Press.

THIS is an interesting book. In it Dr. Zipf reports his discovery that in the United States and certain other nations at certain periods the population sizes of cities and towns form approximately a harmonic series, so that the rank of the city times its population size is a constant. This discovery may rank with Quetelet's discovery that the statures of men are distributed in accordance with the so-called normal probability curve. Dr. Zipf is greatly to be congratulated upon his perspicacity in making it.

He shows how the specialization of wealth and labor and the prevalence of exchange must produce an organization of the population into communities with some inverse relation between population-size and the number of communities, though this inverse relation could have many forms other than that of the harmonic series. Nobody, I judge, will dispute this. He argues that the distribution of communities to form a harmonic series must be related to and significant of something in the organization of a nation's life and work. Nobody should dispute this, though there will be many opinions about just what it signifies. He then argues that such a distribution to form a harmonic series signifies an "equilibrium" in a nation's affairs, and that such an equilibrium will tend to restore itself if it is disturbed by any force. "We shall find that any disturbance to the equilibrium of any social-economic system tends automatically to set forces in operation within that system to repel the source or to neutralize the effect of the disturbance in order to restore equilibrium" (p. 145). Though this doctrine will appeal to many sociologists, and to some biologists, it seems to the reviewer to be unwise, especially the second half of it. The valuable factual material relating the distribution of community sizes in various nations at various periods can, I think, be studied better without assuming any potency whatever in an "equilibrium" as such.

Dr. Zipf is led by his reflections on the harmonic series as a product of the social-economic organization of a nation to many comments of a more or less speculative nature on divers topics in history, sociology and government. I quote a few of them chosen almost at random:

"A nation may very well be a natural bio-social entity, quite comparable, in fact, to that of a colony of ants, or of bees, or of termites" (p. v).

"American paranoid tendencies may be felt to have reached their highest point in the last World War when the whole country, under an attack of mass-hysteria, crusaded 'to make the world safe for democ-

racy' with all the delusions of grandeur, utopia, persecution and self-righteousness that are the stereotyped symptoms of this most vicious of mental diseases" (p. 79).

"As for the hope for a single world-wide all-inclusive homogeneous superstate with a single capital, the author finds no historical nor dynamic justification for it" (p. 182).

"Boundaries can be drawn" [in treaties or other agreements between nations] "in such a way that those living within the remaining boundaries and desirous of surviving can in fact survive only by reversing either (1) the physical laws of nature, or (2) the biological laws of nature, or (3) the psychological laws of nature" (p. 205).

"The author suspects that the cyclical business disturbances ('business cycles') of the past and present may conceivably be attributed in part to the alternation between an 'elite' and the 'entire nation' as the 'right number' for which the goods of society are produced" (p. 318).

"Indeed the turmoil of war and strife are perhaps to be viewed primarily as the correctives and 'cures' of maladjustments, rather than as their causes" (p. 404).

Opinions of experts in history, economics, government, psychology and sociology will vary widely concerning most of the dicta of which these are samples.

E. L. THORNDIKE

## TEMPERATURE

*Temperature. Its Measurement and Control in Science and Industry.* American Institute of Physics. xiii + 1362 pp. New York: Reinhold Publishing Corporation. \$11.00. 1941.

IN 1919 the American Institute of Mining and Metallurgical Engineers sponsored a Symposium on Pyrometry under the chairmanship of the late George K. Burgess. The resulting volume of papers, now long out of print, became one of the standard source books on temperature measurement. The book under review is likewise the published record of a symposium, but of considerably greater scope than the 1919 undertaking. Instead of being confined to temperatures above 500° C, it covers the whole range from absolute zero to stellar temperatures, and from highly "theoretical," i.e., logical, considerations on thermodynamics through to the most practical instructions on how to control a furnace temperature when one is compelled to.

As might have been expected, the resulting 126 papers by 160 authors differ greatly in length, in interest and particularly in pertinence. The contributions by the high- and low-temperature physicists stick closest to the theme of the book; they are the least readable, and will be found ultimately the most useful. The contributions by the biological group are the most

interesting, and tell the least about temperature measurement. The temptation to write at length about the results rather than the methods of some very ingenious thermometry was too much for the physiologists and some of the engineers, but they do lend a variety that the old Pyrometry Volume lacked. The amount of information released by the metallurgical industries is disappointing, for reasons easily understandable in a year when commercial and national rivalries were rapidly becoming intensified. The section on thermometric metals and alloys, however, is timely and informative. In the engineering group the contributions from the petroleum industry are the best. The wide range of the subjects may be indicated by citing papers on the thermometry of lamp filaments, volcanoes and liquid helium.

A particularly valuable part of the book is the section of 32 pages devoted to tables, containing the most

authoritative data now available to the thermometrist and including some that have not previously been published in current technical literature. This section of the book, bound in covers, is separately purchasable for \$1.00.

Although the National Research Council made a grant of funds and twelve of the leading technical societies took an active part, both officially and through individual members, in organizing the symposium, the most effective help came from the thermometrists of the National Bureau of Standards, as is fitting for a volume intended to be an expanded sequel to Dr. Burgess's classic text and his earlier symposium.

The reviewer considers this volume indispensable for any technical or scientific library worthy of the name.

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## THE UNIVERSITY OF CHICAGO'S FIFTIETH ANNIVERSARY SYMPOSIA

A CORDIAL invitation is extended to scholars and scientists to attend a series of symposia and lectures in connection with the celebration of the fiftieth anniversary of the University of Chicago.

Nearly all the symposia and lectures will be held during the five days, September 22-26, inclusive. The American Association for the Advancement of Science will meet at the University of Chicago during this period, and the program in the sciences will be under the joint auspices of the university and the association. It should be noted, however, that the symposia on Astronomical Spectra (Yerkes Observatory, Williams Bay, Wisconsin, September 10-13), Respiratory Enzymes and the Biological Action of the Vitamins (September 15-17) and the Training of Biologists (September 18-20) will be held in advance of the meetings of the association.

More than one hundred visiting scientists and scholars, in addition to approximately fifty members of the university's faculties, will participate in the program, the general theme of which will be "New Frontiers in Education and Research."

In view of the limited capacity of the university's lecture halls, it is important that every one who desires to attend the symposia and lectures communicate as soon as possible with the Director of the Fiftieth Anniversary Celebration, the University of Chicago, and indicate the particular sessions in which he is interested. A copy of the announcement containing detailed information of the program and of housing accommodations for visitors will be sent on request.

The program of the symposia, in condensed form, is as follows:

*September 13-15. Astronomical Spectra. At Yerkes Observatory.* Participants: R. Wildt, R. C. Williams, W. Morgan, J. P. Kuiper, P. W. Merrill, T. Dunham, Jr., H. N. Russell, D. H. Menzel, M. Schwarzschild, P. Swings, A. B. Wyse, Otto Struve.

*September 15-17. Respiratory Enzymes and the Biological Action of the Vitamins.* Organized jointly by the University of Wisconsin and the University of Chicago, with sessions at Madison September 11-13. The program at Chicago will be devoted largely to the vitamins, and is supported by a grant from Abbott Laboratories. For the program of this symposium, address T. R. Hogness, University of Chicago.

*September 18-20. The Training of Biologists.* Under the chairmanship of P. A. Weiss. Fifteen members of the faculty of the University of Chicago and ten scientists from other institutions will participate in round-table discussions.

*September 22. Growth and Differentiation in Plants.* Charles E. Allen, University of Wisconsin; Edmund W. Sinnott, Yale University; John W. Mitchell, U. S. Department of Agriculture; John M. Beal, University of Chicago. Ezra J. Kraus, chairman.

*Approaches to Linguistics.* Edgar H. Sturtevant, Yale University; Amado Alonso, University of Buenos Aires; Clarence H. Faust and Charles W. Morris, University of Chicago. Clarence E. Parmenter, chairman.

*The Editing of a Text.* Edwin C. Armstrong, Princeton University; Gustave O. Arlt, University of California at Los Angeles; Rae Blanchard, Goucher College; William Roach, University of Pennsylvania; and Charles H. Beeson and James E. Hulbert, University of Chicago. William A. Nitze, chairman.

*Organic Chemistry.* William A. Noyes, Jr., University of Rochester; Louis P. Hammett, Columbia University;

Linus C. Pauling, California Institute of Technology; James Franck, Frank H. Westheimer and George W. Wheland, University of Chicago.

*Environment and Education.* Ernest Alexander, Institute of Psychoanalysis; Margaret Mead, American Museum of Natural History; Ernest W. Burgess and W. Lloyd Warner, University of Chicago. Robert J. Havighurst, *chairman*.

*The Public Social Services: Fifty Years of Progress.* Martha Eliot, Children's Bureau, U. S. Department of Labor; Florence Allen, judge of the U. S. Circuit Court of Appeals, Cincinnati, Ohio; Carter Goodrich, Columbia University; and Helen R. Wright, University of Chicago. Edith Abbott, *chairman*.

*September 23. Life at High Altitudes and Aviation Medicine.* Carlos Monge, University of San Marcos (Lima, Peru); David B. Dill, U. S. Army Air Corps; E. S. Guzman Barron, University of Chicago. Anton J. Carlson, *chairman*.

*Levels of Integration in Biological and Social Systems.* Libbie H. Hyman, American Museum of Natural History; James W. Buchanan, Northwestern University; Herbert S. Jennings, the Johns Hopkins University and the University of California at Los Angeles; Ralph W. Gerard, William Burrows, Thomas Park and Warder C. Allee, University of Chicago. William H. Taliaferro, *chairman*.

*Interpretation and Criticism of Art and Literature.* Charles R. Morey, Princeton University; Lily Bess Campbell, University of California at Los Angeles; Van Meter Ames, University of Cincinnati; Bernard Weinberg, Washington University; Elder Olson, Illinois Institute of Technology; Honri Frankfort, G. Haydn Huntley, Robert Vigneron and Norman F. MacLean, University of Chicago. Ronald S. Crane and Ulrich A. Middendorf, *chairmen*.

*Organic Chemistry.* Lawrence O. Brockway, University of Michigan; Francis O. Rice, Catholic University of America; Morris S. Kharasch, University of Chicago.

*Surface Chemistry.* Fritz London, Duke University; John G. Kirkwood, Cornell University; Henry Eyring, Princeton University; William D. Harkins, University of Chicago.

*The Changing Bases of National Economy.* John M. Clark, Columbia University; Frank H. Knight and Theodore O. Yntema, University of Chicago. Paul H. Douglas, *chairman*.

*Management's Adjustment to the Changing National Economy.* Willard L. Thorp, Dun and Bradstreet; Lewis C. Sorrell, Raleigh W. Stone and James W. Young, University of Chicago. William N. Mitchell, *chairman*.

*The Conceptual Structure of Educational Research.* Thomas R. McConnell, University of Minnesota; Douglas E. Scates, Duke University; Frank N. Freeman, University of California. Guy T. Buxwell, *chairman*.

*September 24. Visual Mechanisms.* Selig Hecht, Columbia University; Ernst Gellhorn, University of Illinois; Samuel H. Bartley, Washington University; Karl S. Lashley, Harvard University; Arlington C. Krause, Heinrich Kluver, Theodore J. Case and Stephen Polyak, University of Chicago.

*Levels of Integration in Biological and Social Systems.* Clarence R. Carpenter, Pennsylvania State College and the

School of Tropical Medicine (Puerto Rico); Alfred L. Kroeber, University of California; Alfred E. Emerson and Robert E. Park, University of Chicago. Robert Redfield, *chairman*.

*Philosophic Procedures in the Arts and Sciences.* Robert L. Calhoun, Yale University; Clarence I. Lewis, Harvard University; George Gentry, University of Texas; Friedrich Kessler, Frank H. Knight, and Charles Hartshorne, University of Chicago. Richard P. McKeen, *chairman*.

*Surface Chemistry.* Eugene Guth, University of Notre Dame; Henry B. Hull, Northwestern University; George H. A. Clowes, Eli Lilly and Company; Eli F. Burton, University of Toronto; Irving Langmuir and Vincent J. Schaefer, General Electric Laboratories; Ernst A. Hauser and A. J. Grossman, Massachusetts Institute of Technology; George E. Boyd, University of Chicago.

*Measurement and Experiment.* Samuel S. Wilks, Princeton University; Louis L. Thurstone, University of Chicago. William F. Ogburn, *chairman*.

*Civilisations in Transition.* Michael I. Rostovtzeff, Yale University; Hu Shih, ambassador of China to the United States; Robert H. Lowie, University of California. Louis Gottschalk, *chairman*.

*September 25. Thoracic Diseases.* Evarts A. Graham, Washington University; John Alexander, University of Michigan; Clayton G. Loosli, William E. Adams, Robert G. Bloch and Oswald H. Robertson, University of Chicago. Dallas B. Phemister, *chairman*.

*Problems in Historical Materials.* William L. Westermann, Columbia University; Alfred P. Dorjahn, Northwestern University; Ray Frantz, University of Nebraska; Leon C. MacKinney, University of North Carolina; S. R. Tompkins, University of Oklahoma; Richard P. McKeon and Bernadotte E. Schmitt, University of Chicago. Wilbur K. Jordan, *chairman*.

*Frontiers of Knowledge in the Geologic Sciences.* Ralph E. Grim and Gilbert H. Cady, Illinois Geological Survey; Reginald A. Daly, Harvard University.

*The Place of Law in Society.* Charles H. McIlwain, Harvard University; Hans Kelsen, formerly Geneva (Switzerland) Graduate Institute of International Studies and Prague (Czecho-Slovakia) German University; Robert H. Lowie, University of California. Charles E. Merriam, *chairman*.

*September 26. Sex Hormones.* Edward A. Doisy, St. Louis University; John S. L. Browne, McGill University; Carl R. Moore, Allan T. Kenyon and Fred C. Koch, University of Chicago. Frank R. Lillie, *chairman*.

*Immunological Mechanisms.* Linus Pauling, California Institute of Technology; Thomas M. Rivers, hospital of the Rockefeller Institute; William Bloom, Paul R. Cannon, and William H. Taliaferro, University of Chicago. George F. Dick, *chairman*.

*Archeology as a Tool in Humanistic and Social Studies.* Robert L. Engberg, American School for Oriental Research at Jerusalem; Michael I. Rostovtzeff, Yale University; William L. Westermann, Columbia University; Harold R. Willoughby, Neilson C. Debevoise, and Richard A. Parker, University of Chicago. Albert T. Olmstead, *chairman*.

*Administrative Agencies: Recommendations of the Attorney-General's Committee.* John F. Dulles, of the New York Bar; Walter Gellhorn, Columbia University; John Dickinson, University of Pennsylvania. Wilbert G. Katz, chairman.

*Frontiers of Knowledge in the Geologic Sciences.* Richard F. Flint, Yale University; A. I. Levorsen, American Association of Petroleum Geologists.

*Cosmic Rays.* Robert A. Millikan, California Institute of Technology; Bruno Rossi, Cornell University; William P. Jesse, Marcel Schein, Subrahmanyan Chandrasekhar and Ernest O. Wollan, University of Chicago.

*The Place of Ethics in Social Science.* Richard H. Tawney, University of London (tentative); Charles H. McIlwain, Harvard University; Jacques Maritain, Catholic Institute of Paris, Columbia University; Robert M. Hutchins, University of Chicago. John U. Nef, chairman.

In addition to the symposia, there will be the following lectures:

*September 22. The Social Implications of Vitamins.* Robert R. Williams, Bell Telephone Laboratories.

*September 23. The Physiology of the Amino Acids.* Donald D. Van Slyke, Rockefeller Institute for Medical Research.

*September 24. Spinors and Projective Geometry.* Os-

wald Veblen, Institute for Advanced Study. *Some Unsolved Problems of Theoretical Dynamics.* George D. Birkhoff, Harvard University. *Textile Research in the Interest of the Consumer.* Ruth O'Brien, U. S. Bureau of Home Economics.

*September 25. The Historical Interpretation of Art and Literature.* Halvan Koht, former Secretary of State of Norway. *Tuberculosis as the Chemist Sees It.* Florence B. Seibert. The Henry Phipps Institute. *Glaciation and Submarine Valleys.* Reginald A. Daly, Harvard University. *Advancing Frontiers of Nursing Education.* Isabel M. Stewart, Columbia University.

*September 26. The Significance of Choline as a Dietary Factor.* Charles H. Best, University of Toronto. *Virus Infection of the Mammalian Foetus.* Ernest W. Goodpasture, Vanderbilt University. *Nuclear Transformations.* Ernest O. Lawrence, University of California. *The Cosmical Abundance of the Elements.* Henry N. Russell, Princeton University.

The program of symposia and lectures will be followed immediately by an Academic Festival, September 27-29, the principal events of which will include an Alumni Assembly, a Service of Thanksgiving and Commemoration, a Reception of Delegates, a Festival Concert and a Convocation, at which honorary degrees will be conferred.

## SPECIAL ARTICLES

### THE AGGLUTINATION OF RED CELLS BY ALLANTOIC FLUID OF CHICK EMBRYOS INFECTED WITH INFLUENZA VIRUS

WHEN the allantoic fluid from chick embryos previously infected with strains of influenza A virus was being removed, it was noted that the red cells of the infected chick, coming from ruptured vessels, agglutinated in the allantoic fluid. Since red cells in the allantoic fluid of chick embryos inoculated with sterile materials did not agglutinate at all, it seemed that this agglutination phenomenon might be the result of infection with influenza virus in the chick.

To demonstrate the agglutination phenomenon in the infected chick embryos, the egg shell was opened over the air sac. The outer chorio-allantoic membrane was torn away, and several large blood vessels were purposely ruptured. Fifteen to 30 seconds were allowed for the embryo to bleed into the allantoic fluid before the contents of the allantoic sac were emptied into a petri dish. If the embryo had been infected with influenza virus, macroscopic agglutination of the red cells occurred within 15 to 30 seconds in the petri dish. If the agglutination did not appear promptly, it usually did not occur at all, and the differentiation between positive and negative eggs was easy. Virus titrations and serum neutralization tests were then set up in eggs, with this agglutination phenomenon as an

index of infection. Egg-passage viruses and ferret sera were used in these tests. One tenth cc of the material was inoculated into the allantoic sac of 11-day old embryos which were then allowed to incubate for 2 days. The eggs were opened by the method described above, and positive and negative reactions were recorded. By using eggs in the same way that mice are used in serum titrations and virus titrations, it was found that serum neutralization tests and virus neutralization tests could be performed. The end points were as sharp as those obtained in the mouse test. The agglutination reaction worked equally well with strains of influenza A or B virus and with swine influenza virus. Cross neutralization tests were then set up with these viruses, which gave results consistent with the specificity of these strains as established in mice. A neutralization test with acute and convalescent serum from a case of influenza A demonstrated a rise in antibody titer in the convalescent serum which was consistent with the rise obtained in similar tests in mice.

Throat washings have been passed in eggs, and while this phase of the work is in a preliminary stage, we have so far isolated two strains of influenza A virus directly from throat washings and obtained the agglutination phenomenon in the chick embryo on the second passage. The virus from these throat washings was set up in a neutralization test with A and B antiserum in

eggs and its identity as A virus was established. In one case the total elapsed time from inoculation of the throat washings until the confirmation of the identity of the virus by specific serum was only 9 days. Whether B virus and other as yet undescribed viruses from influenza cases will behave similarly is now being determined.

At present neither the mechanism of the agglutination phenomenon nor its specificity for influenza virus infection is well understood. However, the following facts have emerged:

(a) When infected allantoic fluid, either fresh or stored at  $-72^{\circ}$  C. (from which the red cells had been removed by low-speed centrifugation), was mixed in a test tube with washed normal adult chick red cells, an agglutination phenomenon occurred. This *in vitro* agglutination was somewhat slower than the one previously described. Here a positive agglutination reaction was usually visible in 5 to 20 minutes. The red cells sedimented rapidly and formed a characteristic, ragged, granular pattern on the bottom of the tube. If red cells were added in the test tube to allantoic fluid from uninfected chicks, only the slow sedimentation of red cells occurred with no aggregation, and in settling out the cells formed a sharp round disk in the bottom of the tube. If the allantoic fluid from chicks infected with PR8 virus was diluted before adding the red cells, agglutination was still visible in a concentration of 1:512 (final concentration of allantoic fluid).

(b) When normal chick embryo red cells were added in sufficient numbers to allantoic fluid and allowed to settle out, over 99 per cent. of the virus disappeared from the supernatant fluid.

(c) When the allantoic fluid was centrifuged (45 minutes, 11,500 r.p.m.) the "titer" of the supernatant in terms of agglutinating capacity dropped approximately four times. This fall in agglutinating titer was consistent with the expected drop in virus titer as determined by previous tests in mice with the same fluid which showed that 70 to 90 per cent. of the virus was sedimented.

(d) If, instead of infected allantoic fluid, the supernatant from centrifuged ground mouse lung infected with PR8 mouse passage virus was used, the added red cells agglutinated in a dilution as high as 1:5000 (final concentration of mouse lung).

(e) When influenza A ferret antiserum (PR8) in dilutions as high as 1:1024 was mixed with allantoic fluid infected with the homologous virus, the agglutination phenomenon was inhibited. The inhibition was specific, that is, influenza B ferret antiserum in dilutions as low as 1:8 failed to inhibit the agglutination of red cells by fluids containing influenza A virus.

(f) Such inhibition also occurred with human serum, and in Table I is a titration of acute and convalescent

TABLE I  
COMPARISON BETWEEN IN VITRO INHIBITION OF RED CELL  
AGGLUTINATION AND MOUSE NEUTRALIZATION TESTS  
WITH ACUTE PHASE AND CONVALESCENT SERUM  
FROM A CASE OF INFLUENZA A

Serum	Constant amount of infected allantoic fluid tested against various dilutions of serum*	Results of neu- tralization test in mice against uni- form dose of virus†		
	Dilution of serum	Aggluti- nation after 1 hour	No. died	No. survived
Acute .....	1:8	++	4	0
	1:16	+++		
	1:32	+++	4	0
	1:64	+++		
Convalescent ...	1:8	-	0	4
	1:16	-		
	1:32	-	0	4
	1:64	-		
	1:128	-	0	4
	1:256	-		
	1:512	+	3	1
	1:1024	+++		
Saline control, no virus		-		
Virus control, no serum		+++		

\* The W.S. strain of influenza virus was used for the infection of chick embryos.

† The PR8 strain of influenza virus was used for the protection test in mice.

serum from a proven case of influenza A. Dilutions of serum were mixed with a constant amount of W.S. infected allantoic fluid; then a constant amount of chick embryo red cell suspension was added, and the agglutination was read in 1 hour. The change of titer of this agglutination-inhibiting substance following infection is obvious and appears to be of the same order of magnitude as the rise in the patient's neutralizing titer against PR8 virus as determined in the mouse.

Such an *in vitro* test as shown in Table I will be of great advantage over the mouse neutralization tests if it can be shown that it measures influenza neutralizing antibodies. Our results so far suggest that the amount of agglutination-inhibiting substances in sera parallels the neutralizing antibody titer more closely than the complement-fixing titer. Whether this *in vitro* test will be sensitive and specific enough to replace the mouse protection method for determining serum neutralizing antibodies, is a problem at present under investigation. A more complete report will be published at a later date.

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#### ON THE SPECIFIC ADSORPTION OF ALCOHOLS AT THE SALICYLALDEHYDE/WATER INTERFACE

DURING a recent investigation by one of us (D.F.C.) of the interfacial tensions between water and mixtures of isoamyl alcohol and salicylaldehyde, it was observed that, over a wide range of isoamyl

alcohol content, the interfacial tensions were so low as not to be measurable with the Du Noüy tensiometer. In order to study this phenomenon in another aspect,

the E.M.F.s of the cell— $\text{Hg} \mid \text{Hg}_2\text{Cl}_2 \mid 0.0001\text{ N. KCl} \mid A_1$   
 $\text{Salicylaldehyde (1)} \mid B_1 \mid \text{Sat. KCl} \mid B_2 \mid \text{Salicylaldehyde (2)} \mid A_2$

—were investigated. Alcohols were titrated by means of a microburet into the oil phase (2). Precautions were taken to ensure proper mixing. The E.M.F.s were measured by means of an electrometer valve circuit and a compensating potentiometer.

A large series of alcohols was thus investigated. It was found that, in comparison with most primary normal alcohols, isobutyl and isoamyl alcohols caused a much larger initial drop in the E.M.F. curve, whereas secondary octyl alcohol showed a markedly smaller effect (see Fig. 1). The most surprising re-

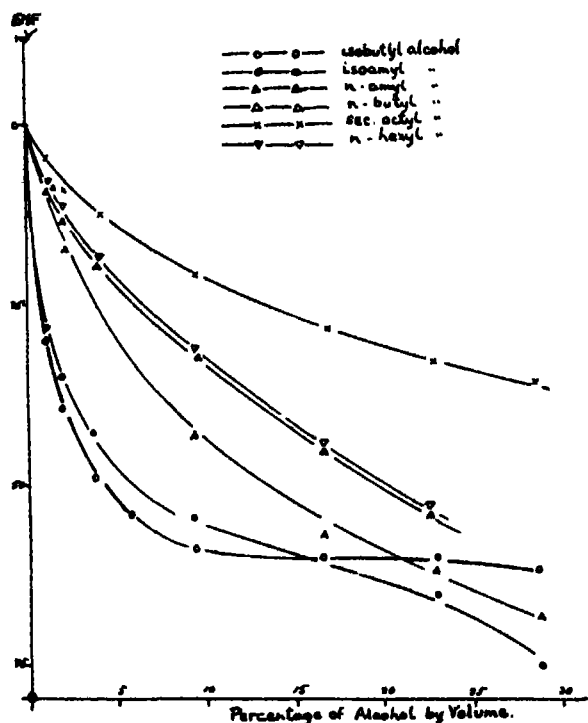


FIG. 1

sults of the investigation were, however, the larger effects shown in general by alcohols containing odd numbers of carbon atoms in the chain and the distinct specificity shown by normal heptyl and nonyl alcohols. The changes in the E.M.F. of the cell occasioned by the addition of 4 per cent. by volume of homologous

primary normal alcohols to the oil phase (2) are shown in Fig. 2, where the E.M.F.s are plotted

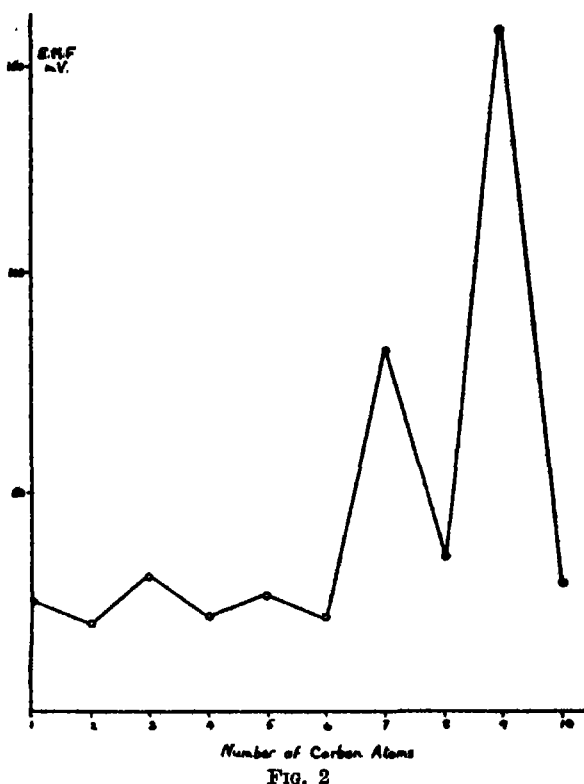


FIG. 2

against the numbers of carbon atoms in the alcohol chains. It will be observed that the heptyl and nonyl alcohols give effects several times greater than those of the other primary alcohols, while the nonyl effect is the greater of the two. The point X indicates the E.M.F. for a similar system containing secondary octyl alcohol, which differs from the heptyl alcohol by a methyl group in the 1-position.

The primary alcohols benzyl and phenyl ethyl alcohols give effects of the same order of magnitude as those of most normal alcohols, whereas cyclohexanol gives a curve whose slope is much greater.

Measurements on the cell— $\text{Hg} \mid \text{Hg}_2\text{Cl}_2 \mid \text{Sat. KCl} \mid$   
 $\text{Salicylaldehyde (1)} \mid \text{Salicylaldehyde (2)} \mid \text{Sat. KCl}$   
 $\text{Hg}_2\text{Cl}_2 \mid \text{Hg}$ —indicated that the titration of al-

cohol into the oil phase (2), which was separated from (1) by either a porous membrane or a long diffusion path, caused only minor potential changes. In the original cell, therefore, the principal phase boundary effect must have been located at the interface  $A_2$ , the interfaces  $A_1$ ,  $B_1$  and  $B_2$  being almost constant.

We have been led to the conclusion that the effect is due, directly or indirectly, to the interfacial adsorp-

tion of the alcohols at the salicylaldehyde/water interface. We consider that changes in the polar characteristics of the interfacial layer of salicylaldehyde molecules and water dipoles are induced by the alcohol molecules in accordance with their steric disposition. These changes at the  $A_2$  interface will lead in turn to electrical asymmetry of the cell, due to different states of ionic distribution at the  $A_1$  and  $A_2$  interfaces. The salicylaldehyde/water interface may therefore be considered as having the properties of a specific receptor for alcohols with certain arrangements of the carbon chain.

The phenomena described above may conceivably lead to a clarification of certain selective phenomena in biological systems, such as, for example, the changes in the properties of local anesthetics caused by different carbon chain arrangements and the specificity shown by the olfactory chemoreceptors.

Further observations are proceeding, and their results, together with a more detailed account of the above, will appear in the *Arkiv för Kemi*, Stockholm

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## EXPERIMENTAL VITAMIN P DEFICIENCY

RUSZNYÁK and Szent-Györgyi<sup>1</sup> were the first to find that flavones (citrine) behave like vitamins in man. The new vitamin was named P vitamin, because of its effect on the permeability of capillaries. Later Bentsúth, Rusznyák and Szent-Györgyi<sup>2</sup> found that scurvy in guinea-pigs is not only due to vitamin C deficiency, but is a mixture of deficiency in C and P vitamins. Zilva<sup>3</sup> could not confirm these later experiments, and

Szent-Györgyi<sup>4</sup> did not succeed in reproducing them. Two years ago Zacho<sup>5</sup> showed that the diminution of capillary resistance in guinea-pig scurvy has no connection with a lack of ascorbic acid, and can only be made to cease with citrine. It seemed that with the help of a method based on this result vitamin P deficiency could be studied and the efficiency of various citrine preparations controlled. Our own experiments are in agreement with those of Zacho, and we succeeded in showing that those citrine preparations which have a therapeutic action in man, cause the diminished capillary resistance to disappear in the guinea-pig. As it appeared that the scurvy diet is not only deficient in ascorbic acid, but in flavones also, we have studied the effect of a scorbutogenic diet on rats. It is well known that the rat does not develop scurvy even on a diet lacking ascorbic acid. It appeared that under the influence of a scorbutogenic diet the rats did not, in fact, develop scurvy even after a long period of time, but their capillary resistance, measured with the Borbély method, diminished considerably in 5 to 6 weeks. When we gave such rats with diminished capillary resistance 3 to 4 mgm. of citrine per day subcutaneously, their capillary resistance became normal in 10 to 14 days. It became clear, therefore, that one can study vitamin P avitaminosis and control the efficiency of citrine preparations on guinea-pigs with scurvy and rats kept on a scorbutogenic diet. These animal experiments are in entire agreement with the results of Scarborough,<sup>6</sup> who has recently published observations which prove the occurrence of isolated P avitaminosis in man.

ST. RUSZNYÁK  
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MEDICAL CLINIC,  
SZEGED, HUNGARY,  
MARCH 28, 1941

## SCIENTIFIC APPARATUS AND LABORATORY METHODS

### PREPARING NITRATE-FREE SEA WATER

In the photometric or colorimetric determination of nitrate in sea water by the "reduced strychnine" method, nitrate-free sea water of the same chlorinity as the water being analyzed is required for the preparation of the standard solutions used in the estimation of the unknown solutions or calibration of the photometer.

Harvey<sup>1</sup> first mentioned the difficulty of obtaining nitrate-free sea water. However, he made the

observation that surface water from the English Channel during the spring months usually contained less than ten microgram atoms of nitrate-nitrogen per liter. (A microgram atom is a millionth of a gram atom.) Riddell<sup>2</sup> also observed that at the time of extensive bottom flowering certain waters from the Georgia Straits were nitrate-free. Unfortunately, naturally occurring nitrate-free sea water is not always available when needed. Because of this sea water is often freed of nitrate by conversion of the nitrate to ammonia by boiling for several hours with amalgamated

<sup>1</sup> *Nature*, 138: 27, 1936.

<sup>2</sup> *Ibid.*, 138: 798, 1936; 139: 326, 1937.

<sup>3</sup> *Biochem. Jour.*, 31: 915, 1488, 1937.

<sup>4</sup> H. W. Harvey, *Jour. Mar. Biol. Ass. United Kingdom*, 14: 71-88, 1926.

<sup>5</sup> *Hoppe-Seyler's Zeits.*, 255: 126, 1938.

<sup>6</sup> *Acta path. scand.*, 16: 1411, 1939.

<sup>7</sup> *Lancet*, 2: 644, 1940.

<sup>8</sup> W. A. Riddell, *Jour. Biol. Board Canada*, 2: 1-11, 1936.

zinc and sulfuric acid. This method introduces considerable quantities of  $\text{ZnSO}_4$  and is somewhat uncertain.

A better method of freeing sea water of nitrate has been used by the authors in which the ability of certain pelagic plants, such as algae and diatoms, to extract nitrate from sea water, even when contained in glass bottles, has been utilized.

Samples of surface water were collected on August 1 from the bay at Friday Harbor, Washington, on an incoming tide. The plankton population at this time consisted largely of diatoms. Two-liter samples, contained in glass bottles, were placed where they would receive a maximum of diffuse light but little direct sunlight. The change in nitrate concentration was followed over a period of seventeen days, Table 1,

TABLE 1  
REMOVAL OF NITRATE FROM SEA WATER BY PLANKTON\*

Days	$\mu\text{g} \text{ PO}_4\text{-P}$ per liter		$\mu\text{g} \text{ NO}_3\text{-N}$ per liter			
	0	4	9	12	14	17
1.65	39	39	37	15	23	0.0
3.00	27	22	22	15	0.6	0.5
3.50	66	72	68	33	20	1.6
4.00	70	68	73	40	29	6
4.50	32	23	13	7	6	
5.00	11	44	47	30	6	0.0

\*  $\mu\text{g}$  or microgram atom is equivalent to gram atom  $\times 10^6$ .

using a modification of Harvey's reduced strychnine method.<sup>3</sup> Two or three ml samples of water that had been filtered through a Jena G-3 fritted-glass filter were mixed with an equal volume of reagent. The color was allowed to develop for three to five hours in the dark and then the white sediment was separated from the red solution by centrifugalization. The color estimations were made with the Zeiss-Pulfrich photometer using a variable cell depth of 1-10 mm and the S-53 color filter. The instrument had been calibrated against standard solutions of potassium nitrate in nitrate-free sea water of the same chlorinity.

No special control was exercised over the presence of animals or bacteria, the type of plants involved or the abnormal conditions of environment. These probably affected the rate of photosynthesis of the diatoms more than any small differences in concentration of nutrient salts. As shown in Table 1, the phosphate concentration was varied but had no effect on the rate of nitrate removal. The addition of plankton, collected from the bay with a hand net, accelerated the nitrate removal in general, although the nitrate concentration occasionally increased at first. Probably this was due to bacterial action on the plankton killed by removal from their natural habitat.

As soon as the samples became nitrate-free, the suspended organisms were removed by filtration and mer-

<sup>3</sup> H. W. Harvey, *Rapp. et Proc-Verb.*, 53: 68-74, 1929.

curie chloride was added to prevent the formation of nitrate through bacterial action on the dissolved albuminoidal nitrogen. Eight ml of saturated solution per liter of sea water was an effective amount and did not interfere with the subsequent determination of nitrate. The water was stored in paraffined bottles until used.

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### SMOOTHING COLORS APPLIED BY COLORED PENCILS

BRANDON GROVE, of the Vacuum Oil Company, Madrid, Spain, described in the April 4 issue of SCIENCE a seemingly "new" method of smoothing colors applied by colored pencils. This method is so old in the U. S. Forest Service that I tried to determine its origin. As I have been in the Service only twenty-two years I went to our head draftsman, here in Missoula, Joe Halm. He could not tell me because—"When I started out coloring maps, in 1912, the old timers showed me how to use gasoline to smooth and fix the colors"! Standard rubbing pencils called "stomps" are obtainable from any draftsman's supply store which are absorbent and permit a much better job of gasoline smoothing than can be done with a cloth, as recommended by Mr. Grove.

Mr. Halm informed me that his CCC trainee-draftsmen, at the Nine Mile Camp, have recently discovered something that was new to him, however. The boys have found that the liquid used in Pyrene fire extinguishers is just as good and much cheaper than drug store or c.p. carbon tetrachloride for removing colors which for some reason have to be changed or eliminated. The commercial Pyrene fluid is also better than carbon tetrachloride for cleaning tracings which have been soiled in the process of inking. The Pyrene does not thin the India ink lines as much as c.p. carbon tetrachloride. After it has evaporated colored crayons and gasoline smoothing can be used without any thinning or weakening of the colors.

H. T. GISBORNE

NORTHERN ROCKY MOUNTAIN FOREST AND  
RANGE EXPERIMENT STATION

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KOLTHOFF, I. M. and J. J. LINGANE. *Polarography*. Pp. xvi + 510. 141 figures. Interscience Publishers. \$6.00.  
LEHMER, DERRICK H. *Guide to Tables in the Theory of Numbers; National Research Council Bulletin No. 105*. Pp. xiv + 177. The Council, Washington. \$2.50.  
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## MATHEMATICS AND THE SCIENCES<sup>1</sup>

By Professor C. V. NEWSOM

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A CLOSE inspection of the history of mathematics and that of physical science reveals the mutual dependence of the two fields of thought. At times mathematical development has been definitely stimulated by the needs of science; at other times scientific progress has been extremely rapid because of the availability of the necessary mathematical devices. It is interesting to observe, however, that serious reflection upon the actual relation of mathematics to the sciences has awaited the twentieth century. Such consideration, stimulated by a better understanding of the nature of mathematics, needs greater publicity, for it is the immediate cause of the mathematizing of parts of science previously untouched by mathematical treatment. This paper,

then, will briefly review some of the factors which are of importance in any attempt to understand the relation of mathematics to the sciences. Implicit in the discussion is a broad definition of mathematics; my only apology for such a point of view is that it is the modern one.

Certainly it is true that a natural science originates with inductive procedures. The inspection of many similar situations in an effort to perceive those constant principles to be designated as laws must always remain fundamental. However, a time comes in the life history of a science when such methods are no longer adequate. Lapicque<sup>1</sup> has expressed the thought in the following words:

<sup>1</sup> Address of the retiring president of the Southwestern Division of the American Association for the Advancement of Science, Lubbock, Texas, April 30, 1941.

<sup>1</sup> L. Lapicque, "L'orientation actuelle de la Physiologie," in *L'orientation actuelle des sciences* (Paris, 1930). The translation employed here was given by C. N. Moore in SCIENCE, v. 81: p. 31, 1935.

Formerly, not very far back in the history of humanity, let us say a century ago, almost everything was unknown concerning the physiology in the labyrinth of the living body. Magendie said: "I wander around there like a rag picker, and at each step I find something interesting to put in my basket." This maxim horrified my teacher, Dastre, who was wont to say: "When one doesn't know what he is looking for, he doesn't know what he finds." For him the ideal of physiological research would have been to conceive in the quiet of one's study a theory explaining such and such a phenomenon, known but not understood, then to find, still by meditation, the experiment capable by a yes or a no, of proving or disproving the theory. One would come then some morning to the laboratory, and that very evening the matter would be decided. These two tendencies, each in its amusingly exaggerated form, seem to me to serve the purpose of characterizing the temperament of naturalists and that of physicists. In proportion as physiology develops, the discoveries for rag pickers become more rare, and the possibility of working as Dastre dreamed is approaching.

In the preface of Woodger's epoch-making book entitled "The Axiomatic Method in Biology,"<sup>2</sup> he explains his attitude similarly as follows:

In every growing science there is always a comparatively stable, tidy, clear part, and a growing, untidy, confused part. I conceive the business of theoretical science to be to extend the realm of the tidy and systematic by the application of the methods of the exact or formal sciences, i.e., pure mathematics and logic.

What, then, is the method of mathematics? Essentially, it is typified by an organization of the propositions of a science into those which are to be accepted as primary or basic and those which may be logically deduced from them. The former propositions are known as the axioms of the science, the term axiom signifying only that the statement thus designated is not proved within the system, whereas the latter propositions are called the theorems or secondary propositions.

To a great extent the original choice between axioms and secondary propositions is arbitrary. The axioms should constitute a consistent set of statements; moreover, they should be entirely ample for the deduction of the remaining propositions of the system when the rules of inference accepted as an adjunct to the system are applied. If a proposition is found among the set of axioms which is a logical consequence of other axioms, its status, of course, should be changed to that of a secondary proposition. Also, it is frequently possible to keep the mathematical organization of a science intact by replacing a collection of the axioms by a smaller number of more primitive statements; sometimes such new axioms may not have been accepted previously as propo-

sitions within the science. As a result of this latter process, it is often true that some axioms will be of such a nature that their truth-property can not be studied directly through the medium of empirical procedures.

The subject-matter symbols of a science organized in the manner just described may not be part of the usual language of the science. In fact, the language of most sciences was not introduced for the purpose of facilitating the construction of a logical structure, and progress toward that end virtually demands some use of the symbolism of mathematics and logic. The success of Woodger in accomplishing a rather elegant mathematical organization of some portions of biology is due partly to his use of a special set of symbols augmented by the symbolism of the "Principia Mathematica" of Whitehead and Russell.

When a logico-deductive system of the type under consideration includes no interpretation of the subject-matter symbols, it becomes a structure in pure mathematics. Of course the rules of inference are valid, and actually are more readily applied, if the basic set of axioms is uninterpreted. It is important to note, however, that the propositions within such a system assert nothing about any part of science, for they convey no meaning. In this connection we recall the familiar statement of Russell that "Mathematics is the subject in which one never knows what he is talking about nor if what he says is true." It is even doubtful that a typical non-assertive statement in mathematics should be characterized as a proposition; it merely has the form of a proposition. Also, any notion of truth-property vanishes from the system, and the concept of consistency becomes the important factor.

So, from some points of view, a mathematical structure may not possess meaning, but it certainly has form. In fact, a structure in pure mathematics may be likened to a pattern or a model or, perhaps better, to a skeleton. It has been constructed by an expert who knows how to link propositions through the use of the rules of inference, the chain starting with a few propositions which are taken as primitives. Charles Sanders Peirce, the Harvard logician, recognized this years ago when he said, "I consider that the business of drawing demonstrative conclusions from assumed premises, in cases so difficult as to call for the services of a specialist, is the sole business of the mathematician." Again he stated, "The business of the mathematician is to frame an arbitrary hypothesis, which must be perfectly distinct at the outset, so far, at least, as concerns those features of it upon which mathematical reasoning can turn, and then to deduce from this hypothesis such necessary consequences as can be drawn by diagrammatical reasoning."

<sup>2</sup> J. M. Woodger, "The Axiomatic Method in Biology," p. vii. London: Cambridge University Press, 1937.

Through the ages, mathematicians have constructed many of the symbolic skeletons which constitute the field of pure mathematics. Some of them are only superficially different, but that fact is irrelevant to this discussion. Suffice it to say here that there has been a frenzy in mathematical circles in recent years; the pace in mathematical research has become faster and faster as new mathematical structures are created and old ones perfected or extended. Such matters are of interest to the scholar, but the writer of this paper must insist that mathematics would become a dead subject and mathematicians an economic liability if the structures of pure mathematics should cease to be of great importance in the sciences.

The task of covering a mathematical skeleton with the flesh which is the substance of a science is not always simple. It requires, first of all, the discovery of a mathematical structure which possesses an axiomatic basis capable of becoming the foundation of the science under consideration when the subject-matter symbols are properly interpreted. In other words, a mathematical structure becomes a system in theoretical science when the subject-matter symbols are properly particularized in meaning. When such precise correspondence, as is implied here, is attained between the fundamentals of a mathematical structure and the primitives of a science, the same definite correspondence is maintained throughout the two systems; that is, the system in pure mathematics and the science organized through its use are identical in form or are isomorphic. In view of the extensiveness of most mathematical structures which are available, success in fitting a mathematical structure to the data of a science may immediately increase knowledge relative to that science many times over. Scientific discoveries which have attended the use of the method have been little short of astounding.

At this point a brief consideration of a very simple mathematical system might be of interest. It should be recalled that meaning is not a necessary ingredient, so the uninitiated may regard a mathematical system as mere jargon. The symbolic system which characterizes "simple order" is of frequent use to mathematicians, and is concerned with a set of elements, A, B, C, etc., and a relation designated by the symbol R. There are three axioms; namely,

1. If A is different from B, then either A R B or B R A.
2. If A R B, then A is different from B.
3. If A R B, and B R C, then A R C.

Not many propositions can be logically deduced from these axioms, but a typical consequence is the proposition,

4. A R B and B R A is false.

An application of the mathematics of simple order

may be found in biology when studying the procreation of yeast cells. A new yeast cell first appears as a bud upon the parent cell. The young cell ultimately separates from its parent, becomes mature, and then begets new cells, one at a time. Every cell has essentially the same kind of a life history. If, now, some one cell is designated by a letter of the alphabet exclusive of R, its first offspring by another letter, the first progeny of the second lettered cell by another letter, and so on, the axioms just given will be satisfied if R is assigned the interpretation, "is an ancestor of." In fact, the axioms become

1. If yeast cell A is different from yeast cell B, then either A is an ancestor of B or B is an ancestor of A.
2. If A is an ancestor of B, then A is different from B.
3. If A is an ancestor of B, and B is an ancestor of C, then A is an ancestor of C.

Now by referring to the mathematical proposition 4 which was deduced as a logical consequence of the original axioms, the valid assertion may be made that

4. A is an ancestor of B and B is an ancestor of A is false.

Such a conclusion is obvious, for the situation studied is a simple one, and the mathematical system employed is elementary. Perhaps, however, persons unfamiliar with mathematical studies can now partially appreciate how a similar technique can be of value in the study of complicated situations when involved mathematical systems are necessary.

Among the numerous other applications of the mathematics of simple order is the specific ordering of a set of temperature readings. This may be accomplished by employing the letters, A, B, C, etc., to denote various temperatures, and by giving to R the interpretation, "is higher than."

The studied use of mathematical methods in science is not new. Archimedes organized a treatise upon some aspects of mechanics before the second century, B.C., in which the deductive procedures of mathematics are brilliantly displayed. Archimedes had been schooled in Euclidean methods while at Alexandria, and his contributions to geometry and mechanics are a manifestation of his rigorous training. The first book of his treatise on mechanics entitled "On Plane Equilibria or Centres of Gravity of Planes" contains fifteen propositions deduced from seven axioms, and demonstrations are given for the determination of various centers of mass which are virtually identical with those still employed in elementary books upon mechanics. His second book of ten propositions extends the work of the first book to more difficult consideration.

It appears that Sir Isaac Newton believed in the possibility of inventing a theoretical science which

would be of universal application to the study of the physical universe. In attempting to organize his science, he assumed mass points of invariable mass to be the basic entities. He then proceeded to the consideration of the necessary fundamental propositions involving such mass points. The foundation which he conceived is familiar to every student of physical science; however, it is incomplete from a mathematical point of view.

In 1788, Lagrange published his analytic mechanics. For the first time, a science of mechanics was systematized by the use of mathematical methods. In the preface to his masterpiece, Lagrange wrote, "No diagrams will be found in this work. The methods which I expound in it demand neither constructions nor geometrical or mechanical reasonings, but solely algebraic operations subjected to a uniform and regular procedure." Within his organization he explicitly stated a hypothesis, for example, upon which the well-known principle of the composition of forces is founded. Throughout the treatment, Lagrange insisted that the principles of mechanics are developed from assumptions, and, apparently, he did not believe that such principles form a system of absolute truths discovered by some group of scientists working in partnership with the Deity.

In modern times, the use of the mathematical method in science is becoming common. Some parts of the axiomatic basis for the theory of relativity are probably better known than are other aspects of the theory. The beginning student in mechanics should be given the opportunity to read Huntington's modern work entitled "The Logical Skeleton of Elementary Dynamics,"<sup>3</sup> for the mathematical approach in Huntington's development is quite satisfying. The economist with ample background is usually impressed with the possibilities of which he has a glimpse in some modern mathematical studies upon economic problems.<sup>4</sup> The work of Woodger in biology has already been mentioned. The number of such studies is rapidly increasing, and a definite impetus has recently been given to the careful consideration of the organization of a science by the early publications of the committee sponsoring the "International Encyclopedia of Unified Science."<sup>5</sup>

It seems foolish to the mathematician for any one to advocate that the use of the mathematical method is the certain cure for all the ailments of science. Yet achievements resulting from its use have been so

notable that some men have made the doubtful declaration that what Descartes dreamed is true: that it is possible to arrive at a complete mechanical interpretation of the world in the exact terminology of mathematics. This expresses the attitude of the extreme mechanist. Irrespective of one's point of view upon this controversial question, all will admit the potency of the mathematical method when circumstances are such as to justify its use. In fact, many persons, even scientists, have developed a certain awe of mathematics. For them it may be surprising to read Bridgman's statement, "It is the merest truism, evident at once to unsophisticated observation, that mathematics is a human invention."<sup>6</sup> In other words, one of man's best-known devices for interpreting nature possesses the same elements of strength and weakness that belong to man himself. The significance of this fact is closely related to the underlying philosophy of all science.

The subject-matter of any science is a collection of sense-experiences which originally appear as a chaotic variety. In attempting to interpret such a collection of experiences, science seeks some pattern to which they appear to conform. Thus the recognized object of science is the development of mechanisms, a mechanism being simply a man-made schema or model which purports to relate a set of natural phenomena in a rational manner. A mechanism may be pictorial, as is the conventional atomic model portrayed to elementary students of physical science, or it may be diagrammatic like the device employed by the organic chemist to display the manner in which a large number of atoms may cling together to form a complex molecule. So, just as the architect's blue-print possesses a correspondence to the finished house, the mechanism of the scientist is made to correspond to some part of nature.

A mathematical structure when applied as a correlating agent to the data of a science merely becomes a mechanistic device, and must be regarded as such by the scientist. It is the belief of many, however, that the mathematical mechanism has merits which others do not possess. For example, deductive reasoning as rigidly employed in mathematics is the only means yet developed for isolating hidden assumptions and for following the subtle implications of the various hypotheses. Moreover, the basic entities of a science are conveniently recognized as those which are represented by subject-matter symbols that are not explicitly defined within the mathematical system employed; in fact, such symbols are given an implicit definition by the set of primitive statements in which they occur.

<sup>3</sup> E. V. Huntington, *Amer. Math. Monthly*, 24: 1-16, 1917.

<sup>4</sup> Note, for example, G. C. Evans, "Mathematical Introduction to Economics." New York: McGraw-Hill Company, 1930.

<sup>5</sup> Note Volumes I and II. "Foundations of the Unity of Science," edited by Otto Neurath. Chicago: University of Chicago Press, 1938.

<sup>6</sup> P. W. Bridgman, "The Logic of Modern Physics," p. 60. New York: Macmillan Company, 1927.

The systematization which mathematics gives to a science is never static, and the science thus organized takes on a directed growth. Some investigators will always be concerned with the reorganization of the axiomatic base of the system, and especially with the possibility of decreasing the number of the axioms. Other students of the science will be making additional deductions from the accepted body of propositions, and new propositions obtained thereby will furnish the suggestion for more experimentation. In fact, the mathematization of a science must never be regarded as a substitute for experiment, for experimentation is continually necessary for confirmation of the theoretical structure. One experimental result contrary to that predicted by the mathematical theory may be sufficient to cause a thorough revision of the theory, or perhaps relegate the whole thing to the grave of false hopes. Of course, many factors must be considered before a theory is actually discarded; for instance, a simple theory furnishing quite approximate results may be employed in preference to a very complex theory which is considerably more accurate in its interpretation of nature.

There is a strange fact about all these mechanistic devices which have been invented and employed by man in his effort to comprehend nature. They are first called laws of science, then, perhaps, laws of nature. After a while man is inclined to forget that they are products of his own imagination, and comes to believe that they are real and a part of creation. This fact has been responsible for many unfortunate attitudes and points of view. So some comments pertaining to the true relationship between a mathematical theory and that portion of nature which it is designed to interpret may be appropriate.

First of all, it must be emphasized that modern science recognizes the ultimate complexity of nature, and any theory which science may employ is too simple to have exact structural similarity to any part of nature. The mathematician may seek a linear formula that best represents the trend of a random set of points which are distributed, however, so as to suggest a straight line; in like manner, the scientist systematizes his study by the use of a mathematical pattern which can reflect only the general behavior of the data of his science. Moreover, it is doubtful that there is a unique theory to be sought by the

scientist laboring in any field, for as Bliss<sup>1</sup> has said, "There are always more mathematical theories than one whose results depart from a given set of data by less than the errors of observation." The Ptolemaic and Copernican theories of the solar system furnish illustrations of two essentially different theories which, after slight modification of the former, describe equally well the behavior of the planets. The modern popularity of the Copernican theory is due chiefly to its relative simplicity.

A serious misunderstanding in regard to the mathematizing of science is apparent in the writings of some popularizers of scientific theory. In many instances, such writers read into nature a lot of fantasy which has its origin in some mathematical property of the theory under discussion rather than in the data from nature which the theory is designed to systematize. Of course, an adequate discussion of such matters must penetrate deeply into the subject of scientific methodology. An example of this type of misunderstanding is to be found in the insistence of some persons that the universe is finite, simply because the finite geometry of Riemann has been used with considerable success as a correlating agent of the data of the astronomical universe. Similarly, there is no justification for stating that continuity is a property involved in a set of data when a calculus of continuous functions has proved valuable in studying it. Many mathematical properties, as a matter of fact, are ideal, and their precise mathematical meaning could not be realized in the physical universe.

It should be evident by now that there are many interesting problems involved in any consideration of the relationship of mathematics to the sciences. In truth, as a field of study, science and philosophy have only touched the fringe. Real progress in analyzing the many difficulties involved demands more investigators with greater versatility of interest and preparation. Mathematicians need to become more familiar with the sciences, and many scientists must appreciate that a knowledge of mathematics consists of more than a mere ability to manipulate a few mathematical symbols. In the meantime, humanity awaits the many fine accomplishments which will result from a greater mutual understanding between mathematicians and the scientists.

## FORTIFICATION OF FOODSTUFFS<sup>1</sup>

By Professor J. MURRAY LUCK

STANFORD UNIVERSITY, CALIFORNIA

It is doubtful whether a single nutrition conference, out of the many that have been held in the past year,

<sup>1</sup> G. A. Bliss, *Am. Math. Monthly*, v. 40, p. 472, 1933.

<sup>2</sup> Nutrition Conference: University of California, Berkeley, California, May 8, 1941.

has not given some attention to the fortification of foodstuffs with vitamins and minerals. The interest of the public and of the food manufacturer in the problem is evidenced by the increasing number of

vitamin-enriched foods in grocery stores and the endless array of vitamin products on the shelves of every drug store.

The arguments in favor of vitamin fortification are essentially these:

(a) The American housewife on her usual diet of about 2,000 kilocal. per day is unable, despite much ingenuity in the selection of foodstuffs, to satisfy her requirements for the various vitamins as computed from the generally accepted standards.

(b) Any given foodstuff, such as milk, for example, varies greatly from day to day, season to season, or place to place, in its vitamin content; incidentally, food tables that purport to give the vitamin values for various foodstuffs are notoriously inaccurate and misleading and have to be used with the greatest of caution.

(c) The incidence of malnutrition, especially of subclinical vitamin-deficiency disease, is high. In some cases malnutrition is endemic. Usually those in the low-income groups are the greatest sufferers but in many cases even the well-to-do are afflicted because of bad dietary habits.

(d) The use of highly processed refined foodstuffs, as instanced by white flour, C. P. sucrose and margarine, deprives us of valuable food factors present in crude or raw products. Additional losses of considerable magnitude may arise through faulty kitchen technique.

Of the several arguments that have been advanced against the fortification of foodstuffs there are only three or four that need to be regarded as serious:

(a) Fortification with pure vitamins is necessarily expensive, even though we make due allowance for the increasing economies that are being effected in quantity production.

(b) The removal of vitamins during the processing of foods and their subsequent restoration to the same or even to other foodstuffs is a practice repugnant to one's feeling for the fitness of things: it does not make sense.

(c) Enrichment with pure vitamins fails to give recognition to the fact that there are almost certainly additional accessory food factors, as yet undiscovered; the inference is that, were it feasible from the standpoint of food technology, fortification with crude concentrates would be better than with pure vitamins. This argument rests upon the very plausible assumption that 50 mg of pure ascorbic acid are not the equivalent, nutritionally, of 50 mg of ascorbic acid in the form of citrus juices and that 4,000 units of pure vitamin A or carotene are not equal to the crude products or original foodstuffs from which the carotene or vitamin was derived.

It is conceded by many that the problem would be

partly solved if we would reconcile ourselves to the consumption of whole-wheat bread instead of ordinary white bread, for B-complex deficiency is one of the common characteristics of low-cost and low-calorie dietaries. At the same time it is perfectly clear that many of us are so stubbornly constituted that we can be reminded day after day of the virtues of whole-wheat bread without paying any heed to such salutary advice. The difficulty is twofold: our dietary habits are very deeply ingrained, and real whole-wheat bread is more expensive than white bread.

I wish to propose that the problem, in so far as bread is concerned, be attacked by establishment of a price differential in favor of whole-wheat bread. This obviously calls for a direct government subsidy, but it follows that the federal government could seek reimbursement through the taxation of white bread. If the millers and bakers can provide us with whole-wheat bread we are quite justified in transferring white bread to the category of taxable luxury goods.

But a very pertinent question is whether such a scheme would work. Would the consumption of whole-wheat bread be increased? Orr and Lubbock<sup>2</sup> have pointed out that in England the price of a banana was 2d in 1900. By 1937 the price had fallen to 1d and the annual consumption of bananas increased from 2½ million bunches to 20 million bunches. Between 1923 and 1935 the price of grapefruit fell 50 per cent. and the annual consumption increased from 1,200 tons to 59,500 tons. These increases were due to a combination of propaganda and fall in price. In the case of whole-wheat bread we now have the propaganda but not the favorable price. It may be contended without any reservations that the creation of a sufficient price differential in favor of whole-wheat bread would increase its consumption, but determination of the "sufficient" differential is entirely a matter of trial. This program has two real merits: it is capable of immediate execution, and it is conducive to the well-being of the low-income groups who are now the greatest sufferers from malnutrition.

Pure vitamins and even vitamin concentrates might well be conserved for therapeutic purposes where a clinical syndrome of vitamin deficiency is in evidence. Wheat germ, dry yeast, rich sources of ascorbic acid, fish liver oils, etc., are to be recommended in the treatment of subclinical deficiencies, and in virtually all cases where the circumstances are appropriate for deliberate enrichment of dietaries—the feeding of the armed forces, of workers in the defense industries, of civilians exposed to special hazards and strain (residents of communities subject to bombing) and of children in schools. In the last-mentioned instance it

<sup>2</sup> "Feeding the People in War Time," Sir John Orr and David Lubbock (Macmillan, 1940).

is hoped that the existing school lunch program will be so extended as to see to it that every child, regardless of economic status, will receive in the schools one thoroughly good meal every day. Apart from the immediate effects of this program, as reflected in the improved health of our children, there is one long term result of immeasurable value—the formation of sound dietary habits.

Let us be well aware of the fact that for children and adults alike education and propaganda are alone insufficient to effect any appreciable improvement in nutritional practices in measurable time. There is much that must be done that can and should be done speedily.

There is reason to believe that the flour-enrichment program of Great Britain has not progressed far, if at all. In any event, it would be unfortunate if the program failed to develop beyond that for which legislative provision has thus far been made. To supplement the present scheme of fortification it is desirable that the consumption of whole-wheat flour and bread be encouraged by reduction of price through a government subsidy. Of necessity the milling of the grain would have to be done in Great Britain because of the failure of whole-wheat flour to keep well when stored. However, the 12 per cent. of residue from fully extracted wheat is a valuable foodstuff for domestic animals and could be put to a profitable use.

## SCIENTIFIC EVENTS

### THE OFFICE OF SCIENTIFIC RESEARCH AND DEVELOPMENT

THE President of the United States issued on June 30 an executive order establishing the Office of Scientific Research and Development in the Executive Office of the President and defining its functions and duties. Dr. Vannevar Bush, president of the Massachusetts Institute of Technology, now chairman of the National Defense Research Committee, has been appointed director. The first part of the President's order reads as follows:

By virtue of the authority vested in me by the Constitution and the statutes of the United States, and in order to define further functions and duties of the Office for Emergency Management with respect to the unlimited national emergency as declared by the President on May 27, 1941, for the purpose of assuring adequate provision for research on scientific and medical problems relating to the national defense, it is hereby ordered:

1. There shall be within the Office for Emergency Management of the Executive Office of the President the Office of Scientific Research and Development, at the head of which shall be a director appointed by the President. The director shall discharge and perform his responsibilities and duties under the direction and supervision of the President. The director shall receive compensation at such rate as the President shall determine and, in addition, shall be entitled to actual and necessary transportation, subsistence and other expenses incidental to the performance of his duties.

2. Subject to such policies, regulations and directions as the President may from time to time prescribe, and with such advice and assistance as may be necessary from the other departments and agencies of the Federal Government, the Office of Scientific Research and Development shall:

a. Advise the President with regard to the status of scientific and medical research relating to the na-

tional defense and the measures necessary to assure continued and increasing progress in this field.

- b. Serve as the center for the mobilization of the scientific personnel and resources of the Nation in order to assure maximum utilization of such personnel and resources in developing and applying the results of scientific research to defense purposes.
- c. Coordinate, aid, and, where desirable, supplement the experimental and other scientific and medical research activities relating to national defense carried on by the Departments of War and Navy and other departments and agencies of the Federal Government.
- d. Develop broad and coordinated plans for the conduct of scientific research in the defense program, in collaboration with representatives of the War and Navy Departments; review existing scientific research programs formulated by the Departments of War and Navy and other agencies of the Government, and advise them with respect to the relationship of their proposed activities to the total research program.
- e. Initiate and support scientific research on the mechanisms and devices of warfare with the objective of creating, developing and improving instrumentalities, methods and materials required for national defense.
- f. Initiate and support scientific research on medical problems affecting the national defense.
- g. Initiate and support such scientific and medical research as may be requested by the government of any country whose defense the President deems vital to the defense of the United States under the terms of the Act of March 11, 1941, entitled "An Act to Promote the Defense of the United States"; and serve as the central liaison office for the conduct of such scientific and medical research for such countries.
- h. Perform such other duties relating to scientific and medical research and development as the President may from time to time assign or delegate to it.

## THE ASSOCIATED HOSPITAL SERVICE OF NEW YORK

ACCORDING to an announcement made by Dr. S. S. Goldwater, president of Associated Hospital Service of New York, the hospitals and the medical profession of Greater New York and of twelve adjacent counties have been invited to participate in a new non-profit prepayment plan which will provide hospital ward service and all medical services needed for satisfactory clinical treatment.

Affiliated with the service is Community Medical Care, Inc., a new non-profit medical indemnity corporation which received a permit from the State Department of Insurance on June 4. It is under the presidency of Dr. I. Ogden Woodruff, and will be managed by a board of directors consisting of sixteen physicians and eight laymen. The physicians include six past-presidents of County Medical Societies in Greater New York.

The promulgation of the new plan follows more than a year of careful study on the part of the board of directors of the service with the aid of the medical profession, hospital executives, representatives of labor and industry, insurance actuaries and social workers. It has been approved in principle by a special committee of the Coordinating Council of the five County Medical Societies of Greater New York. Details have been submitted to and approved by the State Insurance Department and by the Department of Social Welfare, as required by law.

As soon as a sufficient number of hospitals and physicians signify their willingness to participate, the plan will be offered to groups of workers in industry, many of whom have been asking for a prepayment plan within their means which offers the combination of hospital service and professional care in illnesses requiring hospital admission.

The new plan differs from and supplements the present 3-cents-a-day plan in important respects. The 3-cents-a-day plan, which now has more than 1,250,000 subscribers in the metropolitan area and which during the past six years has paid out benefits amounting to more than twenty-five million dollars, provides hospital service only, in semi-private accommodations. The three-cents-a-day plan was devised for persons of moderate means, who after thus providing for their hospital expenses through a common fund, undertake individually to pay their physicians. Subscribers to the 3-cents-a-day plan pay a subscription rate of \$9.60 per annum on a group payroll deduction basis for individual coverage, or \$24 per annum for family coverage. Under the new plan, which is known as the community ward plan, comparable subscription rates for hospital service will be only \$6 per annum for individuals, and \$13.50 for families. To cover medical fees, which are excluded

under the 3-cents-a-day plan, and which are a distinctive feature of the new combined plan, subscribers to the community ward plan will pay to Community Medical Care, Inc., subscription rates identical with those paid to Associated Hospital Service for hospital care. Thus the rates for combined coverage, including hospital service and all necessary medical care during the subscriber's hospital stay as provided for in the contract, will be \$12 per annum for individuals, and \$27 per annum for families, regardless of the number of dependent children under eighteen years of age.

Because of the reduced or "community" rates which participating hospitals are expected to offer under the community ward plan, subscribers to the plan will be limited to single persons with incomes of \$1,200 or less; subscriptions providing maternity care as well as general medical and surgical service will be available to husbands and wives with combined incomes of \$1,680, and to families including children with incomes of \$2,100 or less. Under the new low-cost plan, hospital service and medical care will not be offered separately but only under a combined contract. Administrative costs will be kept at a minimum. Expenses will be shared equally by the two organizations.

According to Dr. Goldwater, the community ward plan involves no necessary change in existing relations between patient and physician, or between physician and hospital. Subject to hospital rules, subscribers will have free choice among participating hospitals.

The Associated Hospital Service offers its new low-cost plan at the conclusion of its sixth year of successful operation, and at a time when it is in a stronger position than ever before. On May 31 the organization reported to the State Insurance Department total admitted assets of \$6,166,753 and a surplus of \$2,472,247, in addition to a special reserve fund of \$1,000,000 for epidemics and other contingencies.

## THE SCHOOL OF NUTRITION OF CORNELL UNIVERSITY

THE establishment of a School of Nutrition at Cornell University, offering a two-year curriculum for students who have completed three years of preparatory work at the college level, has been announced by President Edmund Ezra Day. Within the scope of the new unit will be all phases of animal and human nutrition. The new school will cut across college lines and will bring to bear on problems of nutrition facilities now distributed in various departments of five colleges of the university, and in the U. S. Nutrition Laboratory, recently established at Cornell.

According to Dr. Day, "the recent National Nutrition Conference at Washington brought out the fact

that not only is there need for training additional specialists in the science of nutrition and its practical applications, but also for consultation services for professional workers concerned with problems involving nutrition. The School of Nutrition at Cornell will provide such consultation services, as well as scientific training for nutrition specialists."

Dr. Leonard A. Maynard, who has been professor of animal nutrition at Cornell University for more than twenty years and who is director of the Federal Laboratory of Nutrition at Ithaca, has been appointed director of the new unit.

In addition to training specialists in the field of nutrition, instruction will be offered in related fields, where some understanding of the problems of nutrition is essential. Agricultural agents, students preparing for institutional management and chemical engineers and others in training to serve the food industries will be given instruction in various phases of handling and utilizing foodstuffs. Courses will be given for conservationists, veterinarians, physiologists, toxicologists and workers in other divisions of animal sciences.

Students who plan to enter the field will take a course covering five years of college training, at the end of which they will receive the degree of master of science in nutrition. During the first three years the curriculum will include required courses in biology, chemistry, physics, mathematics and animal husbandry. There will follow two years of intensive training in the school of nutrition proper, with special emphasis on animal and human nutrition, bacteriology, general pathology, biochemistry, biophysics and food chemistry. Problems of food supply and food distribution will likewise be studied. Graduates of the school who demonstrate unusual competence will have opportunity to continue their work in a program leading to the degree of doctor of philosophy.

Members of the staff of the new school will be drawn from those divisions of the university most directly concerned with nutrition problems. Among them will be Dr. J. B. Sumner, professor of biochemistry; Dr. P. F. Sharp, professor of dairy industry; Dr. L. C. Norris, professor of poultry nutrition; Dr. F. B. Morrison, professor of animal husbandry; Dr. H. H. Dukes, professor of veterinary physiology; Dr. Hazel Hauck, professor of home economics; and Dr. Clive M. McCay, professor of animal nutrition, who has long been associated with Dr. Maynard in studies on the relationship between diet and longevity. Also associated with the work will be Dr. Eugene F. DuBois, professor of physiology at the Cornell Medical College, and other members of the staff at the Medical Center in New York City. In certain of its aspects, the program of the school will be closely affiliated with the School of Chemical Engineering,

which is directed by Dr. F. H. Rhodes, who was recently appointed to the Herbert Fisk Johnson professorship of industrial engineering.

#### THE McDONALD OBSERVATORY

AN agreement has been made by which Indiana University will join with the University of Texas and the University of Chicago in the use of the McDonald Observatory on Mt. Locke in the Davis Mountains of southwestern Texas. Under the terms of the new agreement it has been arranged that Indiana astronomers will use the facilities of the McDonald Observatory for fifteen nights each year. Indiana University will be given full right to the photographic plates of their observations and also the rights of discussion and publication of the results of their investigations.

The McDonald Observatory was made possible through an \$800,000 bequest to the University of Texas by the late William J. McDonald, banker of Paris, Tex., and since its opening it has been manned largely by personnel from the Yerkes Observatory under Dr. Otto Struve. The 82-inch mirror is exceeded only by the 100-inch reflector of Mt. Wilson, Calif. Both mirrors will be surpassed at some future date by the 200-inch telescope of the California Institute of Technology, which is now under construction.

The power of the McDonald Telescope is such that it will take photographs of stars of the order of four hundred million light years distant, and a million times fainter than the faintest star which can be seen by the naked eye. The observatory is situated where climatic conditions are favorable for observations more than three hundred nights a year. The work in astrophysics, which has been carried on at the Yerkes Observatory, has been continued at the McDonald Observatory. Indiana astronomers, under the direction of Professor Frank K. Edmondson, will use the observatory for the study of stellar motions.

#### THE AFFILIATION OF RUSH MEDICAL COLLEGE WITH THE UNIVERSITY OF ILLINOIS

AN agreement has been entered into for Rush Medical College and Clinic, Chicago, to turn over their facilities to the Presbyterian Hospital, and it in turn to become affiliated with the University of Illinois. The Presbyterian Hospital is close to the Chicago campus of the University of Illinois in the West Side Medical Center.

The affiliation adds members of the faculty, the training and research facilities of one of the city's largest and best-equipped general hospitals and a leading dispensary to the Colleges of Medicine, Dentistry and Pharmacy of the university and the research and educational hospitals and institutes. The latter were transferred, by agreement between the Department of Public Welfare and the university, on

July 1. With the taking over of the state research groups and the affiliation with the Presbyterian Hospital and Rush Medical College there is created a leading medical center.

The name of the college will be perpetuated, as members of its staff who have formed the faculty of the College of Medicine of the University of Illinois will be designated "Rush professors." Members of the Presbyterian Hospital staff will be appointed to the clinical staff of the College of Medicine of the university. Future appointments to the hospital staff will be made from nominations made by the university.

The classes given at Rush Medical College will continue for another two years until students already enrolled complete their work. No new students will be enrolled this fall; newcomers will be eligible to apply for admission to the University of Illinois College of Medicine. The property of the college, hospital and dispensary will remain in the names and under the control of each of those organizations for the carrying out of trusts and other agreements.

For the past seventeen years, Rush Medical College, with the hospital and dispensary, have been affiliated with the University of Chicago, which conducts its own medical college. The authorities at the University of Chicago decided either to join the two medical units or to sever the connection. The trustees of Rush Medical College, however, were not willing to accept such an arrangement, and decided to become affiliated with the University of Illinois.

Under the agreement, the University of Illinois will "formulate a comprehensive coordinated program of undergraduate and graduate medical education and research which shall be designed to use jointly the facilities of the Presbyterian Hospital, the Colleges of Medicine, Dentistry and Pharmacy, and the research and educational hospitals and the institutes of the university." Also, the university will "suggest a program of affiliation for the School of Nursing of the hospital."

The University of Illinois group is the second largest in the west side medical center. It is exceeded only Cook County Hospital, which includes eleven buildings forming the largest general hospital in the world.

#### THE CHICAGO MEETINGS OF MATHEMATICIANS

THE forty-seventh summer meeting and twenty-third Colloquium of the American Mathematical Society will be held at the University of Chicago from September 2 to 6, in conjunction with meetings of the Mathematical Association of America and the Institute of Mathematical Statistics. The Econometric Society also meets in Chicago. At the time

of the meetings the University of Chicago will be celebrating the fiftieth anniversary of its founding, the theme of which will be "New Frontiers in Education and Research."

The Colloquium Lectures will be given by Professor Oystein Ore, of Yale University, under the title "Mathematical Relations and Structures." The Josiah Willard Gibbs Lecture will be given by Professor Sewall Wright, of the department of zoology of the University of Chicago. The title of this lecture is "Statistical Genetics and Evolution." In addition to the usual program of short papers there has been arranged a conference on algebra, a conference on the theory of integration and four general lectures designed for the mathematical group as a whole rather than primarily for specialists in the fields of the lectures. These lectures will have the composite title "Trends in Research," and will describe recent progress and suggest directions which future research in the fields may take. They are as follows: "Abstract Spaces," by Professor M. H. Stone, of Harvard University; "Analytic Number Theory," by Professor H. A. Rademacher, of the University of Pennsylvania; "The Calculus of Variations," by Professor G. A. Bliss, of the University of Chicago, and "Topology," by Professor Solomon Lefschetz, of Princeton University.

The twenty-fourth summer meeting of the Mathematical Association of America will be held from September 1 to 4. In addition to a program of special papers on Monday, a joint session of the society and the association will be held on the afternoon of Wednesday, September 3.

A joint dinner of the societies will be held on Thursday evening at seven o'clock in Hutchinson Commons, preceded by an informal reception at the Reynolds Club.

In connection with the anniversary celebration of the University of Chicago, the American Association for the Advancement of Science will hold meetings during the fourth week of September. Section A will have a session on Wednesday afternoon, September 24, at which Professor Oswald Veblen will give an address on "Spinors and Projective Geometry" and Professor G. D. Birkhoff will speak on "Some Unsolved Problems of Theoretical Dynamics." On Friday, September 26, there will be a symposium on cosmic rays, a joint session of Sections B and D (physics and astronomy), and lectures by Professor E. O. Lawrence on "Nuclear Transformations" and by Professor Henry Norris Russell on "The Cosmical Abundance of the Elements." Complete announcements of these and other scientific sessions held during September will be sent to mathematicians on request to the Director of the Celebration, University of Chicago.

## SCIENTIFIC NOTES AND NEWS

DR. JAMES BRYANT CONANT, president of Harvard University, has been appointed chairman of the National Defense Research Committee. He succeeds Dr. Vannevar Bush, who has become director of the newly established Office of Scientific Research and Development.

DR. THOMAS H. NORTON, research chemist of the American Cyanamid Company, celebrated his ninetyeth birthday on June 30.

AT the seventieth commencement of the University of Nebraska the degree of doctor of laws was conferred on Dr. Arthur Sperry Pearce, professor of zoology at Duke University.

A WIRELESS dispatch to *The New York Times* states that Dr. Alexis Carrel has been commissioned by Marshal Pétain's Government to organize in France an institute for scientific and medical research. The institute would be in the occupied zone, where Dr. Carrel is at present. Funds for its operation would be granted through subventions by the State.

THE Lamme Medal "for meritorious achievement in engineering" of the Ohio State University has been awarded to Harry C. Mougey, Detroit, technical director of the Research Laboratories Division of the General Motors Corporation.

AT the annual meeting of the Rochester Academy of Medicine the Albert D. Kaiser Medal "for distinguished service to the medical profession" was awarded to Dr. David B. Jewett in recognition of his efforts in building up the library of the academy.

DR. C. H. DESCH, scientific adviser to the British Iron and Steel Research Council, has been awarded the platinum medal for 1941 of the Institute of Metals "for distinguished services to non-ferrous metallurgy." The medal, which is awarded every year, was presented to the institute by the Mond Nickel Company.

SIR THOMAS LEWIS, University College Hospital, London, has been elected a foreign member in the division of medical research of the Royal Swedish Academy of Science.

ACCORDING to the *Journal* of the American Medical Association the annual award of the faculty of medicine of the University of Berne for research on encephalitis will be made retroactively to Dr. B. Disertori, of Trient, Italy, for 1938 and to Professor G. Panegrossi, of Rome, for 1939.

AT the annual meeting of the American Association for the Study of Allergy held in Cleveland on June 2 and 3, Dr. Milton B. Cohen, of Cleveland, was elected

president; Dr. Samuel Feinberg, of Chicago, president-elect; Dr. Oscar Swineford, Jr., of Charlottesville, Va., vice-president, and Dr. J. Harvey Black, secretary-treasurer.

DR. L. A. CORWIN, of Jamaica, L. I., was elected president of the New York State Veterinary Medical Society at the Ithaca meeting. He succeeds Dean W. A. Hagan, of Cornell University. Dr. H. H. Fehr, of Buffalo, was elected vice-president and Dr. W. J. Hellman, of Utica, treasurer.

DR. HARDY A. KEMP, professor of bacteriology and preventive medicine and dean of the College of Medicine of the University of Vermont, has been appointed dean of the College of Medicine of the Ohio State University. He succeeds Dr. John H. J. Upham, who has retired.

DR. WILLIAM STOCKTON NELMS, since 1920 professor of physics at Emory University, retired from active service with the title emeritus at the close of the college year.

DR. OLIVER REYNOLDS WULF, of the U. S. Department of Agriculture, has been appointed research associate in physics at the Institute of Meteorology of the University of Chicago. He also will take charge of the Chicago station of the U. S. Weather Bureau.

DR. ROBERT J. TERRY, professor of anatomy of the School of Medicine of Washington University at St. Louis and head of the department, retired in June. He will be succeeded by Dr. Edmund V. Cowdry, professor of cytology.

DR. GEORGE F. KAY, of the University of Iowa, will relinquish his administrative work on September 1. He will become dean emeritus and professor of geology. Since Dr. Kay went to Iowa in 1907 he has served for twenty-three years as head of the department of geology, as state geologist for an equal length of time and as dean of the College of Liberal Arts for twenty-four years.

H. P. GOULD retired on July 1 as head of the Division of Fruit and Vegetable Crops and Diseases of the Bureau of Plant Industry after serving for forty years. He will be succeeded by Dr. John R. Magness, who has been a project leader in the division for several years. Dr. Lee M. Hutchins has been appointed chief of the Division of Forest Pathology. He has been in charge of research on virus diseases of tree fruits, working principally in the South and West. He succeeds the late Dr. Haven Metcalf.

PROFESSOR EARLE D. ROSS, of the department of history of the Iowa State College, has been selected

by the Iowa State Historical Society to prepare a history of agriculture in Iowa for the centennial publication of the society. This book, which Dr. Ross, as research associate of the Historical Society, is preparing this summer, will be one of a series to commemorate Iowa's one-hundredth anniversary of statehood in 1946.

DR. HARRY R. HOFFMAN, associate clinical professor of neurology of the Rush Medical College, Chicago, and director of the Cook County Behavior Clinic, has been appointed state alienist of Illinois, taking the place of the late Dr. H. Douglas Singer. He will be succeeded at the clinic by his assistant, Dr. William H. Haines.

DR. SAMUEL GLASSSTONE, research associate in chemistry at Princeton University, has been appointed scientific editor of the Princeton University Press.

DR. ROBERT S. MORISON, of the department of anatomy of the Harvard Medical School, has succeeded Dr. Alexander Forbes as editor of the section of neurophysiology of *Biological Abstracts*. Dr. Ralph G. Smith, of the Medical School of the University of Michigan, has become editor of the section of pharmacology in the place of Dr. Erwin C. Nelson.

DR. SHARAT K. ROY, curator of geology at the Field Museum of Natural History, left Chicago on July 1 for western New York to collect specimens of invertebrate fossils of the Paleozoic era. Dr. Fritz Haas, curator of lower invertebrates, has recently returned to the museum after a two months' expedition to Southern California, where he collected specimens of Pacific shore animals.

DR. MADISON BENTLEY has completed a term as special lecturer in psychology at Goucher College. On June 2 he lectured before the Rochester Psychology Society on "The Hominid Animal from Egg to Age." Since he left the consultanthip in psychology at the Library of Congress his address has been Palo Alto, Calif.

DR. GEORGE W. CORNER, director of the department of embryology of the Carnegie Institution of Washington at the Johns Hopkins University, delivered on May 6 the sixth Leo Loeb Lecture before the St. Louis Medical Society. His subject was "The Ovarian Cycle."

DR. CECIL K. DRINKER, professor of physiology and dean of the School of Public Health of Harvard University, will give from October 6 to 20 a series of five Lane Lectures at Stanford University Medical School, on the general subject of the lymphatic system. The Lane Medical Lectures, given biennially, were founded in 1896 by Dr. Levi Cooper Lane.

It is planned to build a laboratory for medical

physics with a staff of five research workers at the University of California at Berkeley. This has been made possible by a gift of \$165,000 from an anonymous donor to build and equip the laboratory; and a contribution of \$50,000 from the Columbia Foundation of San Francisco for the payment of salaries. The laboratory will represent a union of physics and medicine and other branches of science, such as chemistry, bacteriology, biology and genetics. The plans are under the direction of Dr. John H. Lawrence, who now is in charge of medical investigations with the cyclotron.

By the will of Dr. Robert S. Forsythe, formerly head of the department of book selection at Newberry Library, Chicago, the sum of \$100,000 for research on asthma is bequeathed to Harvard University.

J. P. ANDERSON, of Juneau, Alaska, has given to Iowa State College one of the largest collections of Alaskan plants in the United States. It comprises more than 10,000 specimens. Mr. Anderson, a graduate of Iowa State College of the year 1914, has been active in Alaskan public affairs, recently serving in the territorial legislature and as superintendent of census. He plans to increase the selection further this summer and to carry on research with Alaskan plants at Iowa State College next fall.

THE Institute of Medicine of Chicago announces the establishment of a foundation to be known as the Edwin R. Kretschmer Memorial Fund, given by Dr. Herman L. Kretschmer, the Chicago surgeon, and Mrs. Kretschmer, in memory of their son, who died last February. Income from the fund is to be used for lectures on myelogenic leukemia and for research in the field of blood dyscrasia. Dr. Kretschmer is a member of the Board of Governors of the Institute of Medicine and treasurer of the American Medical Association.

REVISED examinations have been announced by the Civil Service Commission for those qualified in all branches of naval architecture and marine engineering. They are particularly needed for positions in the assistant and associate grades (\$2,600 and \$3,200 a year, respectively). However, naval architects or marine engineers qualified to fill all the grades (salaries range as high as \$5,600 a year) are urged to apply at once, although applications will be accepted until June 30, 1942. The commission will not accept applications from those who successfully passed the examinations for the position of naval architect or marine engineer which closed on June 30, unless they are now eligible for rating in a higher grade. Those who have been placed on the commission's em-

ployment list will be retained on the new list to be established as a result of the examinations just announced. An open continuous examination for inspectors of naval ordnance materials is also announced. No written examinations are being given, but applicants are being rated on the basis of education, training and experience as shown on the applications. Any one under 65 years of age qualified in any of the several fields connected with the work is eligible for positions, which carry salaries ranging from \$1,620 to \$2,600 a year for the various grades. To qualify for either of two higher grades, considerable experience must be shown in one of the four specific branches of naval ordnance: optical and fire control instruments, naval guns and accessories, munitions or ordnance units. In the lower grades an applicant may qualify on education alone or by showing the proper amount of experience in varied fields.

Five members of the faculty of the University of Chicago have been appointed by President Robert Maynard Hutchins as a Committee on Biology and Medicine to further the publication through the University Press of books in the field of medicine and the biological sciences. Members of the committee are: Dr. William H. Taliaferro, dean of the Division of the Biological Sciences, chairman of the department of bacteriology and parasitology; Dr. Franklin C. McLean, professor of pathological physiology; Dr. C. Phillip Miller, associate professor of medicine; Thomas Park, assistant professor of zoology, and Dr. Lester R.

Dragstedt, professor of surgery. The committee will advise the University of Chicago Press of research suitable for publication, will plan needed texts, and act as a possible outlet for valuable work now being done throughout the country in the biological and medical fields. In the matter of securing manuscripts, the committee will be assisted by an advisory group, one man from each department of the biological sciences at the University of Chicago.

THE American Standards Association has announced the publication of a new list of American Standards for 1941. It is pointed out that in view of the importance of standards and specifications not only for every-day work but to speed up production to meet defense requirements, this particular list of standards will be of unusual interest to industry. More than four hundred American Standards are listed, covering definitions, technical terms, specifications for metals and other materials, methods of test for the finished product, dimensions, safety provisions for use of machinery and methods of work. They reach into every important engineering field and serve as a basis for many municipal, state and federal regulations. Six hundred manufacturing, government and user groups have shared in their development. The list will be sent free of charge to any one interested in the work. Requests should be addressed to the American Standards Association, 29 West Thirty-ninth Street, New York, N. Y.

## DISCUSSION

### EVIDENCE OF UNDERTOW FROM ENGINEERING PRACTICE

DOUBTS as to the existence of the undertow were raised some years ago by Professor W. M. Davis.<sup>1</sup> Some years later Shepard<sup>2</sup> described river-like movements of water that here and there flow outward nearly perpendicular to the shoreline, and supported Davis in his suggestion that the undertow is non-existent.

The presence of outward moving surface currents does not, of itself, disprove the existence of undertow, since it is conceivable that water forced on a lee shore by the wind might escape in either or both ways. Investigations by Evans<sup>3</sup> have proved the existence in lakes and ponds of fairly strong subsurface currents which move outward from shore during on-shore winds and are reversed in direction during off-shore winds. This suggests that similar movements may take place in larger bodies of water but does not prove it.

It is evident that both Davis and Shepard in their

discussions have used the word "undertow" in the popular sense of strong subsurface currents moving outward in the comparatively shallow water near shore and have left out of consideration those subsurface movements that occur farther off-shore and which Davis<sup>4</sup> mentioned but seemed to dismiss as of little importance. As originally used, the word "undertow" was intended to apply to subsurface currents extending entirely to the outer edge of the subaqueous terrace and even beyond. Russell says:<sup>5</sup>

The finest of the waste from the land is carried lake-ward by the undertow and finally deposited as lacustral beds; portions less finely comminuted fall on the outer slopes of the terrace and serve to broaden it.

Also Gilbert<sup>6</sup> uses the term in the same way when he says:

The finer portion (of the detritus) being lifted up by

<sup>1</sup> *Op. cit.*, 207, 1925.

<sup>2</sup> I. C. Russell, "Geological History of Lake Lahontan," pp. 88-89, U.S.G.S., Mono. 11, 1885.

<sup>3</sup> G. K. Gilbert, "Lake Bonneville," p. 33, U.S.G.S., Mono. 1, 1890.

<sup>4</sup> *SCIENCE*, 61: 206-208, 1925.

<sup>5</sup> *SCIENCE*, 64: 161-182, 1936.

<sup>6</sup> *SCIENCE*, 88: 279-281, 1938.

the agitation of the waves, is held in suspension until carried outward to deep water by the undertow.

Several studies relating to problems of water supply and sewerage disposal have been made by engineers in the Great Lakes region for the purpose of determining the movement of sewerage, the spread of turbidity and the bacterial count. In discussing such studies Townsend<sup>7</sup> says:

With the wind blowing from the shore, this sewerage flows on the water surface and the pure lake waters flow along the lake bed. When the direction of the wind is reversed, the sewerage flows along the bed and pure water on the surface. The intake gates to the water supply tunnels can be manipulated accordingly.

Burdick,<sup>8</sup> in discussing the conditions at Chicago and Gary, states that with on-shore winds the travel of the surface water is shoreward, that there is an undertow outward, and that the turbidity developed in the shallow water is carried out to the deeper water in this way. He says this turbidity is noticeable at the water intake at Gary with a north (on-shore) wind and that with a south (off-shore) wind the bacterial count is least.

Investigations of methods of protecting the water supply of Milwaukee gave further evidence of subsurface currents.<sup>9</sup> It was found that with an on-shore wind there is an undertow, and that with an off-shore wind there is a subsurface current in the other direction. This wind-induced circulation reached a depth of 65 feet. A somewhat similar study by Whipple<sup>10</sup> regarding sewerage disposal in Lake Erie indicated similar current conditions there. With an on-shore wind the sewage moved off-shore on the lake bottom and with an off-shore wind it moved off-shore at the surface while on the bottom it moved somewhat inshore.

In describing current studies at Squam Lake, New Hampshire, Whipple<sup>11</sup> states:

Floats near the surface drifted with the wind, while the deeper floats moved in the opposite direction. It was found that the greater part of the return circulation was above the transition zone, but that even below the transition zone there was some movement of the water. . . . In summer, when the lake is vertically stratified, these currents remain largely confined to the circulation zone.

According to the studies cited above, wind-induced currents are common and are confined, in summer,

<sup>7</sup> Curtis McD. Townsend, "River and Harbor Construction," p. 83, The Macmillan Company, 1922.

<sup>8</sup> C. B. Burdick, "The Relation of the Intake to Pure Water from the Great Lakes," p. 40, Illinois Water Supply Association Proceedings, 1911.

<sup>9</sup> Metcalf and Eddy, "American Sewerage Practice," pp. 201-204. McGraw-Hill Book Co., Inc., 1935.

<sup>10</sup> *Ibid.*, pp. 197-200.

<sup>11</sup> G. C. Whipple, "The Microscopy of Drinking Water," 4th Edition, pp. 161-162. John Wiley and Sons, Inc., 1927.

mostly to that part of the water body above the thermocline. On the Great Lakes this is from about 50 to 100 feet below the surface. On Squam Lake, at the time the studies were made, the lower part of the thermocline was at a depth of about 48 feet. According to Whipple's diagram, the surface current extended down to a depth of about one third of the distance from the water surface to the bottom of the thermocline, and Metcalf and Eddy's diagrams showing conditions at Milwaukee and at Rochester suggest about the same relation.

On the east shore of Lake Michigan the bottom slope is so gradual that a depth of 15 to 20 feet is not usually reached until 800 to 1,200 feet from shore. Under these conditions it is probable that a definite surface and subsurface circulation is not present near shore during heavy storms and that where the water has less depth than that to which the surface current penetrates, the water movements are uneven and disorganized and the water driven on-shore by the wind escapes outward in localized currents either on the surface or below. It may even move parallel with the shore for some distance before reaching a place where the shoreline and conditions of bottom topography are favorable for off-shore movement. Thus the "rip currents" described by Shepard are a part of this outward movement, but there is sometimes also a subsurface escape in favorable localities, as was observed by Evans<sup>12</sup> on the east shore of Lake Michigan.

The above observations seem to indicate that if we mean by "undertow" an outward moving subsurface sheet of water beneath the layer that is being driven shoreward by on-shore winds, such a current does not exist closer to shore than where the depth of water is about equal to the thickness of the shoreward drifting sheet but that it does exist in the greater depths off-shore. In the zone nearer shore the water movements are localized and may be in any direction and either at the surface or below.

O. F. EVANS

UNIVERSITY OF OKLAHOMA

## A BACTERIAL PATHOGEN OF THE CITRUS RED SCALE

ADULT females and crawlers of the red scale on field lemons can be infected and destroyed, under laboratory conditions, by a spore-forming, nitrate-reducing motile bacterium isolated from a certain soil, in connection with denitrification studies. A similar, if not identical, microorganism was later found in the dead red scale in some lemon orchards.

Spraying with active cultures, immersion and dusting with the spores of the bacterium were studied as methods of bringing about a mass infection of the scale on lemons and on a number of other hosts. Mortality

<sup>12</sup> O. F. Evans, *Jour. Geol.*, Vol. XLVII, No. 3, 1939.

of the adult females was found to be in the vicinity of 100 per cent. under certain conditions. Immersion and dusting with the bacterial spores fruits previously sprayed with water appeared to offer more promise than spraying alone.

Within a few days after the infection the pygidia of the scale often become distorted. Evolution of gas and a more or less general browning of the insect often occur simultaneously. Vegetative cells of the bacterium, as well as its spores, can be observed in the contents of the general cavity. Saprophytic fungi frequently invade the diseased or dead insect.

A detailed article containing experimental data has been submitted to *Phytopathology*.

V. P. SOKOLOFF  
L. J. KLOTZ

UNIVERSITY OF CALIFORNIA

### PRO AND CON EVOLUTION IN CONTEMPORARY GERMANY

THE attacks on evolution, discussed under the above heading in *SCIENCE*, 93: 40, 41, have been also contradicted in two articles of the German monthly *Der Biologe* (year 9, fasc. 12, December, 1940, which was received here in May, 1941).

The first of those articles, by the geneticist, F. Schwanitz (*l.c.*, pp. 407-413), bearing the title "Ein Kreuzzug gegen die Abstammungslehre" ("A Crusade against Evolution"), deals with the "Sonderheft" (4/5, vol. 37, April/May 1940) of "Natur und Kultur," particularly with Otto Muck's essays, which are harshly refuted and stripped of any scientific significance.

The second article, entitled "Immer wieder: Abstammung oder Schöpfung?" ("Again and again: Evolution or Creation?"), by Chr. von Krogh (*l.c.*, pp. 414-417), who recently<sup>1</sup> participated in the German scientific discussion on "Menschwerdung" (origin of man), deals chiefly with an anti-evolutionary pamphlet of H. Frieling,<sup>2</sup> one of the contributors to the aforementioned special publication. Von Krogh rejects it for both scientific and philosophical reasons, claiming that Nordic man always believed in unity of body and soul,

whereas dualism is assigned to Eastern conception of life.

OTTO HAAS

THE AMERICAN MUSEUM  
OF NATURAL HISTORY

### CARL FRIEDRICH GAUSS'S DESCENDANTS IN AMERICA

GAUSS, who is probably one of the four greatest mathematicians who ever lived, was twice married. By his first wife he had two sons (Joseph, 1806-73, and Louis), and by his second also two sons (Eugene, 1811-96, and Wilhelm, 1813-79). Louis died in childhood. Joseph was an engineer, and in 1836 and 1837 he was sent by his government to the United States to study railway construction in the New World. Eugene came to the United States in 1831 and enlisted as a private in the U. S. Army for five years. In 1840 he settled in St. Charles, Mo., married, and had a family of seven children. His younger brother Wilhelm came to this country in 1837, immediately after his marriage to a niece on his mother's side of the astronomer Bessel. For about a score of years he was engaged in farming in Missouri. Thereafter he entered the wholesale shoe business in St. Louis, in which he continued until his death. Of his eight children six were living in 1899. In January, 1935, one of these children, Joseph H. Gauss, was still living, and dean of the Brookes Bible Institute of St. Louis. Other descendants are in Colorado and California. Most of the information given above, and much more, may be found in *C. F. Gauss und die Seinen. Festschrift zu seinem 150. Geburtstage*, herausgegeben von H. Mack, Braunschweig, 1927, and in two articles by Professor Cajori: (a) "Carl Friedrich Gauss and His Children," *SCIENCE*, n.s., v. 9, 1899, pp. 697-704; and (b) "Gauss and His American Descendants," *Popular Science Monthly*, v. 81, 1912, pp. 105-114.

This supplies information requested by a correspondent, Sir Joseph Larmor, in your issue for May 30, page 523.

R. C. ARCHIBALD

BROWN UNIVERSITY

## SCIENTIFIC BOOKS

### MATHEMATICS

*Gap and Density Theorems.* By NORMAN LEVINSON. American Mathematical Society Colloquium Publications. Vol. 26. New York, 1940. viii + 244 pages. \$4.00.

ONE of the fundamental properties of the system of trigonometric functions ( $\cos nx$ ,  $\sin nx$ ), or of the

<sup>1</sup> *Zeitschr. ges. Naturw.*, pp. 105-112, 1940.

<sup>2</sup> "Herkunft und Weg des Menschen. Abstammung oder Schöpfung?" Klett, Stuttgart, 1940 (113 pp.).

equivalent system of exponential functions ( $e^{inx}$ ), is the property of closure. It is precisely this property that makes them so important in problems of expansions of arbitrary functions in Fourier series. The natural question under what conditions this property is enjoyed by a more general system of functions ( $e^{i\lambda_n x}$ ), has interested several earlier writers, among whom the name of G. D. Birkhoff should be mentioned. Several important problems in this direction were

stated and solved by G. Pólya. A new impetus to the problem was given by the work of Paley and Wiener. The first part of the present book (Chapters I-IV) continues the work of Paley and Wiener, and extends it to a final form, in a certain sense. The method of Paley and Wiener, based on the consideration of Fourier Transforms in the complex domain, is successfully used by the author in treating various other problems of the theory of functions of complex variables. Such are problems connected with vanishing of Fourier Transforms, distribution of zeros and singularities of analytic functions, and the rate of growth of analytic functions (Chapters V-VII). In Chapters VIII and IX the author extends the work of Pólya concerning entire functions of zero order and shows that his results are in a certain sense the best possible. Finally in the last part of the book (Chapters X-XII) the author gives a considerable extension of a remarkable theorem of Hardy and Littlewood, where the convergence of a series is derived from its summability by a certain method, without any additional conditions on the terms of the series. Due to its technical character, the reading of the book is not very easy; however, the exposition is very clear and precise, and the reader who will stick to his job will feel greatly rewarded at the end.

*Fourier Series and Boundary Value Problems.* By RUEL V. CHURCHILL. ix + 206 pages. New York: McGraw-Hill Book Company. 1941. \$2.50.

THE literature in English on the subject of partial

differential equations of mathematical physics is rather restricted. Expositions of introductory but not entirely formal nature are practically non-existent, and the present book represents a welcome contribution in this direction. In the first two chapters the author discusses the notion of a boundary value problem for linear differential equations and derives some simplest differential equations of mathematical physics. In the next three chapters the author introduces the notion of orthogonal sets of functions, discusses properties of being closed and complete, and applies the general principles to the special case of trigonometric Fourier series. Simple fundamental facts concerning convergence of Fourier series and operations with Fourier series are discussed here, and the notion of Fourier integral is introduced. Chapters VI and VII give applications to solution of simplest boundary value problems of the theory of heat conduction and potential theory. Much attention is given to the question of uniqueness of solutions. Finally, in chapters VIII and IX the author introduces Bessel functions and Legendre polynomials and considers some applications to boundary value problems. Exposition is clear and "rigorous" as far as possible in a book of elementary character. The notion of Laplace transform is omitted although it seems quite desirable and worth mentioning. The author promises, however, another volume of a more advanced nature where further methods of solving boundary value problems will be treated.

J. D. TAMARKIN

BROWN UNIVERSITY

## SOCIETIES AND MEETINGS

### THE KANSAS ACADEMY OF SCIENCE

THE seventy-third annual meeting of the Kansas Academy of Science was held at Manhattan, Kansas, on April 3, 4 and 5, 1941, with Dean E. O. Deere, Bethany College, Lindsborg, Kansas, presiding. The Kansas Entomological Society, which is affiliated with the academy, held its seventeenth annual meeting on April 5. The following other state societies held their meetings in cooperation with the academy: The Kansas Association of Teachers of Mathematics, the Kansas chapter of the Mathematical Association of America, and the Kansas chapter of the American Association of University Professors. The Weather Crops Seminar, another affiliated society, held its meeting last November.

The academy program opened with a Thursday evening lecture under the joint auspices of the Kansas State College chapter of Gamma Sigma Delta and the academy by President W. M. Jardine, of the University of Wichita, who spoke on "Egyptian Agriculture."

After sectional meetings on Friday morning for Botany, Zoology, Psychology and Geology from 9 to 11 A.M., a general academy business meeting was held. Recipients of the six research awards for 1940 reported briefly on the results of their work.

More definite plans were made for the celebration of the seventy-fifth anniversary of the academy in 1943 at the Lawrence meeting. This "Diamond Jubilee Committee" is planning to prepare an extended report on the chief contributions to science by the various institutions of the state during the seventy-five years of academy activity.

Sectional meetings for Botany, Chemistry, Physics, Psychology, Zoology and a Geological field trip were held on Friday afternoon.

At the annual banquet on Friday evening, Dr. S. A. Nock, vice-president of Kansas State College of Agriculture and Applied Science, spoke appropriate words of greeting and gave a challenge of the times to science and scientists. Dr. J. T. Willard spoke on per-

sonal "Reminiscences" of some of the founders and earlier members of the academy.

The banquet was followed by the annual public meeting, which this year was a joint symposium sponsored by the Mathematical Societies and the academy. Dr. L. C. Heckert, head of the department of physical science at Kansas State Teachers College at Pittsburg, spoke on "Kansas Resources and National Preparedness." Dr. William L. Hart, professor of mathematics at the University of Minnesota, representing the Mathematical Societies, spoke on "Mathematics and National Preparedness."

The next business meeting was held on Saturday morning. President Deere gave his presidential address on "Crowding and its Effect on Organisms." Dr. J. R. Wells reported the decisions of the judges and the names of the winners of the awards of the junior academy meeting. Robert Beck of Manhattan, and Frances Chubb of Lawrence, were nominated for the honorary junior memberships in the A.A.A.S. for the coming year.

Mrs. Otilla Reagan, donor of the Albert B. Reagan memorial fund, attended the meeting and spoke briefly of some pamphlets on the life and work of Dr. Reagan which she has for distribution.

insects at various altitudes by airplane; a \$40.00 Kansas Academy of Science award to Lawrence Oncley and William B. Plum, both of Southwestern College, for research on the vitamin content of the beans of the Kentucky coffee tree. It was decided that, beginning with the awards for 1941, the recipients will not be given their awards in cash but that a credit be established to the amount of each award and that statements or bills be presented by the recipients for apparatus, labor, travel expense or other expense in carrying on the research projects.

Dr. Roy Rankin reported on the death of Dr. W. R. B. Robertson, the only known death in the academy ranks during the year. Dr. W. H. Mikesell, of the University of Wichita, chairman of the committee on educational trends, gave the report of an extended study of the psychology course as given in the high schools of the state.

Total academy registration was 488. In addition, the junior academy had a registration of approximately 200; the Kansas Entomological Society 55; the Mathematical Societies 135; the University Professors 45.

The reports from the section chairmen on their sections is presented herewith in tabular form.

SECTION RECORD, WITH PAST AND FUTURE OFFICERS, MANHATTAN MEETING

Name of section	Chairman of section for the meeting	No. papers on program	No. persons attending	Chairman for 1942
Biology Teachers	H. H. Hall	7	43	R. L. Tweedy
Botany	F. W. Albertson	26	60	Stuart Pady
Chemistry	K. S. Bergstreser	12	90	Leonard C. Kreider
College Students	M. W. Allen	14	120	M. W. Allen
Entomology	R. L. Parker	23	55	Don B. Whelan
Geology	Carl Barnhart	22	55	Geo. M. Robertson
Junior Academy	Don Marchbanks	{ Class A Schools } { Class B Schools }	200	John Michner
Committee Chairman	J. R. Wells			L. D. Wooster
Physics	S. Winston Cram	18	60	K. V. Manning
Psychology	Geo. A. Kelly	18	70	H. E. Schrammel
Physical Science	Lawrence Oncley	Meeting in November	100	R. H. Wheeler
Weather Crops	W. A. Cochei			E. H. Herrick
Zoology	R. E. Bugbee	38		
Kans. Assoc. Teachers				
Mathematics	Mrs. Adelle Davis	5	50	Miss Kathleen O'Donnell
Math. Assoc. of America,				
Kansas Chapter	G. Baley Price	9	85	C. V. Bertsch
A. A. University Professors	R. W. Conover	7	50	A. B. Sageser

Three new life members, Dr. Edwina A. Cowan, Marion I. Campbell and Dr. J. E. Ackert were added to the roll of life members.

The following research awards for 1941 were announced by P. S. Albright, Southwestern College, chairman of the research committee. The \$32.50 Reagan award No. 5 was given to Travis Brooks, Kansas State College, for research on the Myxomycetes of Kansas; a \$40.00 American Association for the Advancement of Science award was made to Leslie L. Eisenbrandt, University of Kansas City, whose research work at Kansas State College is a study of the intestinal mucosa for an inhibitory growth factor for nematodes; a \$35.00 A.A.A.S. award to Leonard H. Moulden, Kansas State College, for aid in collecting

A sectional program for college students was an innovation this year and proved to be so successful that it was made a permanent feature. The section will be managed by an academy committee to insure continuity.

The next annual meeting of the academy and the same cooperating societies for 1942 will be held at Hays, Kansas; the meeting for 1943 will be held at Lawrence and the invitation from Pittsburg, Kansas, was accepted for 1944.

The following officers were elected for the next year and meeting: *President*, F. C. Gates, Kansas State College; *President-elect*, R. H. Wheeler, University of Kansas; *Vice-president*, H. A. Zinszer, Fort Hays Kansas State College; *Secretary*, John C. Frazier,

Kansas State College; *Treasurer*, F. W. Albertson, Fort Hays Kansas State College.

Executive council members are L. D. Bushnell, Kansas State College, E. O. Deere, of Bethany College, and H. H. Hall, Pittsburg. Two associate editors, chosen for three years, are J. A. Trent, Pittsburg State Teachers College; and W. H. Schoewe, of the University of

Kansas. Dr. Robert Taft, of the University of Kansas, is the new editor of the "Transactions." The writer will serve the second year of his three-year appointment as representative to the academy conference at Dallas with President Gates as alternate.

ROGER C. SMITH

MANHATTAN, KANSAS

## REPORTS

### ADDITIONAL COOPERATIVE STUDIES OF THE RELATION BETWEEN MOSQUITO CONTROL AND WILDLIFE CONSERVATION<sup>1</sup>

A PREVIOUS report of the Technical Committee<sup>2</sup> outlined the mechanism for the conduct of investigations for the coordination of programs of malaria control and wildlife conservation in the impounded waters of the Tennessee Valley Authority. This report briefly outlined the studies conducted during the season of 1939. The work of this committee has continued through the summer of 1940 and it is desired at this time to make a brief progress report.

It is recognized that the production of *Anopheles quadrimaculatus* is closely associated with aquatic vegetation. It is also known that certain species of aquatic plants are objectionable, both because they favor the production of mosquito larvae and because they have no value as food for wildlife. This has led to an intensive investigation of the relative importance of various species of aquatic vegetation in the production of *A. quadrimaculatus*.

Quantitative studies were undertaken to determine the relative importance of individual aquatic species in the production of this mosquito. Twenty species of aquatic plants were studied, but emphasis was placed upon nine of these. Plots five yards square were adopted as the unit of study and usually four or more such plots were sampled for each plant species in a given area. Ten square-foot samples were collected from each plot by means of a screen dipper and strainer pan. All anopheline larvae were classified according to their instars, and species determinations were made of most fourth instar larvae. Estimates were made of the vegetative cover and the amount of flottage in each square-foot sampling station. Altogether, 3,000 individual samples were taken during the summer. The results of these studies indicate that, with the possible exception of watershield (*Brasenia schreberi*), which may inhibit larval production, fac-

tors other than the individual species of vegetation are of primary importance in determining the extent of anopheline production in a given area. It was apparent that structure and growth characteristics of the plants and the way they interact with a combination of external factors such as flottage, water-level, wind action, the amount of vegetation edge-line at the water surface, etc., were more significant in anopheline production than were mere species differences. Because of water-level fluctuations for malarial control and variations brought about by floods, navigation, and power uses, the marginal vegetation in the reservoirs of the Tennessee Valley Authority presents problems widely different from those found under more stable conditions. At high-water levels emergent vegetation was important in anopheline production, while at low-water levels submerged species became important. Floating-leaved species were important at both high- and low-water levels. In general, there was a positive correlation between the density of anopheline larvae and the abundance of flottage and frequently with the amount of vegetative cover.

Experimental studies have been conducted on the control of vegetation objectionable to malaria control and wildlife interests. Experimental applications of powdered sodium arsenite were made by airplane at monthly intervals at the rate of approximately eight pounds per acre. With the exception of lotus, the control of the various species obtained by four applications was encouraging. Coppice was particularly susceptible to sodium arsenite. While complete control can not be anticipated at present, it is felt that such applications might reduce the vegetative cover sufficiently to make the application of larvicides more effective and even reduce the need for these. A wide variety of liquid herbicides has been tested on alligator grass (*Achyranthes philoxeroides*), but no definite conclusions have been reached at this time. The utilization of an underwater weed cutter in the control of lotus (*Nelumbo lutea*) and cowlily (*Nymphaea advena*) has given very encouraging results.

Experimental plantings of sixteen species of vegetation important to wildlife have been made in the Wheeler refuge. These plantings indicate that three species suitable for waterfowl, namely, four-angled

<sup>1</sup> Report of the Technical Committee for 1940 by E. Harold Hinman (*chairman*), John Steenis, W. V. King, J. L. Robertson, Jr., A. H. Wiebe, Clarence Tarzwell and A. D. Hess.

<sup>2</sup> E. L. Bishop, *SCIENCE*, 92: 201-202, 1940.

spike rush (*Eleocharis quadrangulata*), soft-stem bulrush (*Scirpus validus*) and three-angled bulrush (*S. americanus*) are tolerant to fluctuation and draw-down of water-level and might be effectively fitted into existing plant associations at certain contours so that they would not add materially to the malaria control problem.

A large number of soil samples for arsenic determinations were taken from the reservoirs in the spring of 1940 prior to the application of Paris green, and similar series in October at the cessation of larvicidal activities. Analyses of these samples show no significant increase in the amount of arsenic in the soil.

A study was conducted to obtain information on the feeding habits of *Gambusia* with special reference to its predation on *Anopheles* larvae. The forage ratio<sup>3</sup> was adopted as a measure of the feeding preference of *Gambusia* for anopheline larvae and pupae. The forage ratio is obtained by dividing the percentage of a given kind of organism in the fish stomachs by its percentage in the environment. The ratio will vary above and below one accordingly as the predator prefers or avoids the particular prey. The forage ratio may be calculated from number, weight or volume of organisms; in this study numerical forage ratios were used. Enclosing the study plots with a barrier seine made it certain that the fish whose stomachs were examined had fed in the same plot from which the samples of food organisms were collected. About 30 square-foot samples were selected at random from each plot to be investigated, and both the macroscopic and larger microscopic organisms were counted and identified. Immediately after the collection of these organisms, the *Gambusia* were collected from the plot, preserved in formalin, and taken to the laboratory for analysis of stomach contents. Three ecological conditions were studied, and in each of these, study plots were selected which contained the maximum number of larvae. One represented typical problem areas of the reservoir subjected to fluctuation; a second was a protected bay of the main reservoir dammed off so that terrestrial vegetation was flooded and the water-level kept relatively constant; the third type was an area newly impounded during the late summer after terrestrial vegetation was well advanced and when wind action had caused flotate concentration. These studies involved the collection and examination of 295 square-foot samples of surface-dwelling food organisms and the collection and examination of stomach contents of 968 *Gambusia*. The feeding preference for anophelines increased as their absolute density increased, the forage ratio being one when the larval density was about two per square foot; above this density the forage ratio increased, and below this density it decreased. The

feeding preference for anophelines increased as the size of the larvae increased; no first instar larvae were found in the stomachs and the forage ratio for fourth instar larvae was greater than for second or third instar larvae. The forage ratio for pupae was greater than for any larval instar. It was concluded that predation of *Anopheles* by *Gambusia* in these areas was sufficient to reduce materially production of adults. However, this reduction is not considered sufficient, under the conditions represented in certain areas, to eliminate the need for other control measures.

Preliminary investigations have been carried on regarding the *Odonata* as predators of anopheline mosquitoes. Dr. Allan F. Archer also conducted certain investigations on the predation of spiders on adult mosquitoes.

Through the cooperation of the Fish and Wildlife Service, the Tennessee Valley Authority and the WPA, provisional plans were made to dyke off an extensive shallow area in the Wheeler Refuge as a means of eliminating a serious anopheline breeding area and at the same time providing a source of winter food for migratory waterfowl. The areas will be dyked off, connected by dragline ditches, and a single pumping structure will be utilized to dewater the area at the onset of mosquito production. The area can then be maintained in a dewatered state throughout the summer, permitting the planting of suitable species of plants for wildlife food. At the close of the mosquito breeding season the area will be flooded to provide feeding grounds for migratory waterfowl. The inclusion of two-way pumps will permit these operations even at times when the lake is at low elevations.

At a joint meeting of the Policy and Technical Committee at Knoxville, December 6, 1940, it was agreed that, since a working relationship now exists whereby a study of these problems may be continued as a part of the regular research programs of the interested agencies, the formal organization should be discontinued. It was stated further that it would be the purpose of the participating agencies to continue at the present or increasing levels the program of cooperative research which has been developed.

#### THE CHICAGO MUSEUM OF SCIENCE AND INDUSTRY

Last fall the Chicago branch of the American Association of Scientific Workers appointed a distinguished committee of its members to look into the problems raised in connection with the dismissal from the Museum of Science and Industry of a number of members of the scientific staff. The accompanying report by this committee has been unanimously approved by the executive committee of the association.

R. W. GERARD,  
President, Chicago Branch

<sup>3</sup> A. D. Hess and A. Swartz, *Trans. 5th North Amer. Wildlife Conf.*, pp. 162-164, 1941.

## REPORT OF THE COMMITTEE

Your committee wishes to report its conclusions in regard to recent dismissals of members of the staff of the Museum of Science and Industry in Chicago. A study has been made of the facts available to us. Our recommendations are given as a part of our findings.

## Preamble

- It seems clear that a change in the general policy of the museum was favored by the trustees, partly in the interest of necessary saving, and that these changes in policy could be furthered by a change in personnel, such as was actually ordered. Whether such changes in policy are themselves desirable is a point on which your committee, having only a limited acquaintance with the management of the museum, can scarcely pass. Such decisions are properly within the responsibilities of the Board of Trustees of the museum. We have, however, no evidence that the Board of Trustees consulted competent men, outside its own ranks and the museum staff, in reaching a decision.
- There may have been budgetary savings in the reorganization effected by the discharges; the significance of such savings your committee is not in a position to evaluate.
- Your committee is pleased to observe that the policy expressed by the president of the museum is to continue emphasis on education rather than on entertainment.

## Findings

- The method of dismissal of the Director and the chiefs of departments, without consultation and without due process, is, in our opinion, contrary to justice and to sound practice, especially in a public educational institution. According to Mr. Lohr, this procedure of avoiding contact with the men before action was taken and basing his decision primarily upon administrative and budgetary needs, was adopted in an effort to avert implications detrimental to the individuals dismissed. We believe that in a public educational institution, staff members, after proven competence, should have tenure and be subject to removal for cause only after a proven hearing. Moreover, from a financial viewpoint, a minimum of ameliorative measures seems to have been taken to lighten the blow upon those discharged. Such amelioration was scaled upon the standards prevailing in business rather than upon those prevailing among scientists.
- We trust that the board will provide more adequate restitution to the persons discharged. Such steps would restore to the museum a place of confidence with the citizens of Chicago and the scientific public.
- It will be helpful to the understanding of the museum's position if its Board of Trustees will make a public statement of its policy.

ANTON J. CARLSON  
ARTHUR H. COMPTON  
CHAS. H. BEHRE, JR.

## SPECIAL ARTICLES

ASSOCIATION OF THE WASSERMANN ANTIGEN WITH HEAVY MATERIALS PRESENT IN TISSUES<sup>1</sup>

THE material present in normal and neoplastic tissues and sedimentable at 27,000 r.p.m. during one hour has been shown to contain the Forssman antigen,<sup>2</sup> tissue and organ specific antigen,<sup>2,3</sup> and several enzymes as cytochrome oxidase, succinic dehydrogenase (heart muscle,<sup>4</sup>) and phosphatase (mouse kidney<sup>5</sup>).

The experiments to be described in this report indicate that these heavy materials also contain the Wassermann hapten since they react with most Wassermann positive human sera even when highly diluted, but not with Wassermann negative sera. Table I shows that the Wassermann hapten, present in saline extracts of beef heart, can be sedimented at about the same speed that is required to sediment the agents producing leukosis and sarcoma of chickens<sup>6</sup> and the

TABLE I  
COMPLEMENT FIXATION TESTS WITH A WASSERMANN POSITIVE HUMAN SERUM AND FRACTIONS FROM BEEF HEART

Antigen dilution	A Crude extract	B Sediment after centrifugation at 15,000 r.p.m.	C Supernatant from B	D Sediment from C after centrifugation at 27,000 r.p.m.	E Supernatant from D
1/1	—	—	—	—	o
1/10	o	o	o	o	ac
1/30	o	o	o	mod	c
1/90	o	mod	ac	c	c
1/270	c	c	c	c	—
1/810	c	—	—	c	—

The sediments were suspended in saline to the original volume.

Abbreviations: o = no hemolysis, tr = trace, sl = slight, mod = moderate, st = strong, ac = almost complete, c = complete hemolysis.

The technique of the complement fixation has been described (6).

heterogeneous and tissue and organ specific antigens. Partial sedimentation of the Wassermann antigen occurs at 15,000 r.p.m. for one-half hour, and almost complete sedimentation at 27,000 r.p.m. for one hour.

Similar results were obtained with saline extracts from human heart tested with a Wassermann positive human serum. The reacting substance, as present in

<sup>1</sup> These studies have been supported by grants from the International Cancer Research Foundation and The Jane Coffin Childs Memorial Fund for Medical Research.

<sup>2</sup> J. Furth and E. A. Kabat, *SCIENCE*, 91: 483, 1940.

<sup>3</sup> W. Henle and L. A. Chambers, *SCIENCE*, 92: 313, 1940.

<sup>4</sup> K. G. Stern, *Cold Spring Harbor Symposia on Quantitative Biology*, 7: 312, 1939.

<sup>5</sup> E. A. Kabat, *SCIENCE*, 93: 43, 1941.

<sup>6</sup> E. A. Kabat and J. Furth, *Exp. Med.*, 71: 55, 1940.

the crude extract, is unstable, and beef heart after autolysis for one week at room temperature contained only a small amount of this material—the complement fixing titre of such material being 1/3 as compared with 1/90 of extracts from fresh tissues.

Table II shows that heavy materials from all tissues tested gave complement fixation tests with the Wassermann positive human serum, but the antigenic titre was lower with the Wassermann positive serum than with the homologous immune serum.

TABLE II

COMPLEMENT FIXATION TESTS OF HEAVY MATERIALS FROM DIFFERENT TISSUES WITH WASSERMANN POSITIVE HUMAN SERUM AND HOMOLOGOUS IMMUNE RABBIT SERUM

Serum	Antigen mg N/ml	Heavy material					
		Human liver	Mouse spleen	Mouse kidney	Chicken spleen	Chicken tumor	Crude extract from chicken tumor
Wassermann positive human serum (1/100)	0.10	—	o	o	o	o	o
	0.033	o	mod	o	st	st	tr
	0.011	o	c	o	c	c	st
	0.0036	st	c	st	c	c	c
Homologous immune serum (1/100)	0.0012	ac	c	c	c	c	c
	0.011	o	o	o	o	o	o
	0.0036	o	st	tr	o	tr	o
	0.0012	tr	ac	st	ac	c	o

All antigen and serum controls showed complete hemolysis. The antigen was used in volumes of 0.2 ml.

Several of these sera contained Forssman antibody, but previous experiments have shown that the reaction with homologous immune serum persists after removal of the Forssman antibody from these sera. The Wassermann positive human serum used did not contain Forssman antibody.

Comparison of the reactivity of several Wassermann positive and negative human sera with the usual Wassermann antigen and with heavy material from human liver shows that the sera react more strongly with the Wassermann antigen (Table III). *E.g.*, serum No. 124 reacted with the alcoholic extract of beef heart to a serum dilution of 1/27, but with heavy material from human liver only to a dilution of 1/9. Two Wassermann positive sera failed to react with heavy material from human liver.

Table I indicates that the Wassermann hapten is contained in a complex antigen of large size. Nevertheless, immune sera obtained by immunization of rabbits with heavy material from different human, chicken and mouse tissues failed to react with alcoholic extracts from beef heart used for the routine diagnosis of syphilis. Sixteen sera prepared with high-speed deposits from human liver, kidney, spleen, from mouse spleen and kidney, and from chicken spleen and sarcoma were tested with the Wassermann antigen in serum dilution 1/20, 1/40, 1/80. Reactions with homologous antigens are shown in Table II. Only one immune serum against the heavy material from mouse kidney gave a positive complement fixation test in

TABLE III

COMPLEMENT FIXATION TESTS OF WASSERMANN POSITIVE AND NEGATIVE HUMAN SERA WITH HEAVY MATERIALS FROM HUMAN LIVER

Antigen	Serum dilution	Serum					
		Wassermann+*		Wassermann+		Wassermann—*	
		No. 188†	No. 124†	No. 197, 181	No. 60, 61, 64	No. 63	No. 62
Purified alcohol extract	1/3	—	—	0	st	0	0
from beef heart	1/9	0	0	0	c	mod	0
	1/27	0	0	mod	c	c	ac
	1/81	c	tr	c	—	—	—
Heavy material from human liver	1/3	mod	0	ac	c	c	c
	1/9	c	0	c	c	c	c
	1/27	c	c	—	—	—	—
Serum control	1/3	ac	ac	ac	c	c	c
	1/9	c	c	c	c	c	c

\* The sera so designated were obtained from the Central Laboratory of New York Hospital through the courtesy of Dr. R. G. Stillman.

† Similar reactions were obtained with 3 other sera.

serum dilution 1/20. The control sera were as follows: 2 sera from normal rabbits, 2 from rabbits immunized with streptococcus, 2 with pneumococcus, 1 with *B. mesentericus*, and 2 with *B. subtilis*. The two sera prepared by immunization with *B. subtilis* gave a positive complement fixation test in dilution 1/20. Many rabbit sera are anti-complementary at dilutions below 1/20.

These observations are consistent with the opinion expressed by Weil and Braun<sup>7</sup> and by Sachs, Klopstock and Weil<sup>8</sup> that the Wassermann reaction results from auto-immunization to lipoidal substances liberated from tissues and activated to a complete antigen by the *Spirocheta pallidum*, as well as with the more recent experiments of Eagle and Hogan<sup>9</sup> indicating that cultured spirochetes contain material serologically related to the substance in normal tissues. Experiments are in progress to determine why Wassermann antibodies are not formed on immunization with heavy material from tissues, although this material is highly antigenic and produces Forssman and other antibodies.

**Summary.** The Wassermann hapten is associated with materials sedimentable at high speed present in normal and neoplastic tissues. Although these heavy materials are strongly antigenic, the immune sera produced by them in rabbits react strongly with homologous heavy materials but do not give a positive Wassermann reaction.

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<sup>7</sup> E. Weil and H. Braun, *Wien Klin. Woch.*, 21: 151, 1908.

<sup>8</sup> H. Sachs, A. Klopstock and A. J. Weil, *Deutsch. Med. Woch.*, 51: 589, 1925.

<sup>9</sup> H. Eagle and E. B. Hogan, *Jour. Exp. Med.*, 71: 215, 1940.

# QUANTITATIVE CHANGES IN THE SUBSTRATE-DEHYDROGENASE SYSTEM OF DROSOPHILA PUPAE DURING METAMORPHOSIS

THE rate of oxygen consumption in the pupae of holometabolous insects during metamorphosis can be expressed by a U-shaped curve. It is first high, then drops rapidly, while in the second half of metamorphosis it gradually increases again, so that before hatching of the imago, the rate often reaches or even surpasses the initial value. This was also shown to be true for *Drosophila* pupae.<sup>1,2,3,4,5</sup> Various theories have been put forward to account for this phenomenon.<sup>6,7</sup> In 1938 I suggested that the fact may be due to quantitative changes in the amount or activity of the oxygen-transferring enzyme system (Warburg-Keilin system, i.e., "Atmungsferment" and cytochromes). This possibility was inferred from the effect of carbon monoxide on the oxygen consumption of *Drosophila* pupae in different stages.<sup>8</sup> Recently Schwan,<sup>9</sup> although criticizing my considerations, reaches the same conclusion. (His criticism, which seems to be insufficiently founded, should be dealt with elsewhere.)

The question still remained, if simultaneously with the changes in the oxygen-transferring system, other catalysts of the oxidation mechanism, especially the substrate-dehydrogenase system (Wieland, Thunberg)<sup>10</sup> will show similar quantitative alterations. In order to clear up this point, experiments were undertaken with four different stages of *Drosophila melanogaster* pupae, using the Thunberg methylene blue technique.<sup>10</sup> The age of the pupae was 5 to 10 hours (stage I), 25 to 30 hours (stage II), 50 to 60 hours (stage III) and 75 to 85 hours (stage IV), respectively, when reared at constant 25° C. temperature. (At this temperature the duration of the whole metamorphosis is 90 to 100 hours.) The stages were selected according to Wolsky.<sup>5</sup>

Preliminary experiments showed that the best results are obtained with 0.02 per cent. methylene blue solution (1 per cent. trunk solution, diluted with physiological saline, pH 6.8). From this 0.2 ccm was brought together with ten pupae in a Thunberg

vacuum tube. The pupae were crushed in the methylene blue, then the tubes evacuated and put in a water bath, which was kept at a constant temperature of  $20 \pm 0.1^\circ$  C. The time was noted at which complete decoloration of the methylene blue set in.

The results revealed great differences as regards amount or activity of the dehydrogenase system in the four stages. With stage I pupae the average time required for complete decoloration was 28.0 minutes ( $\pm 2.6$  standard error, 7 experiments). In stage II the average was 67.4 min. ( $\pm 7.2$ , 9 experiments), in stage III 66.1 min. ( $\pm 6.3$ , 7 experiments) and finally in stage IV 25.6 min. ( $\pm 2.4$ , 8 experiments). As these figures show, the differences between stage I and II, i.e., 39.4 min. ( $\pm 7.7$  standard error) and between stages III and IV ( $40.5 \pm 6.7$ ), are statistically significant. It is interesting to note that in stages II and III the decoloration time is more than twice the time observed in stages I and IV. The data for oxygen consumption are, according to Wolsky,<sup>5</sup> 4.66 cmm per hour per 1 mg dry weight in stage I, 2.23 cmm in stage II, 2.32 cmm in stage III and 5.05 cmm in stage IV. These data, when compared with the results of the decoloration experiments, show a striking similarity as regards the magnitude of differences. Thus the graphic representation of the results of the decoloration experiments gives a U-shaped curve, which is very similar to that obtained for oxygen consumption during metamorphosis (see Fig. 1).

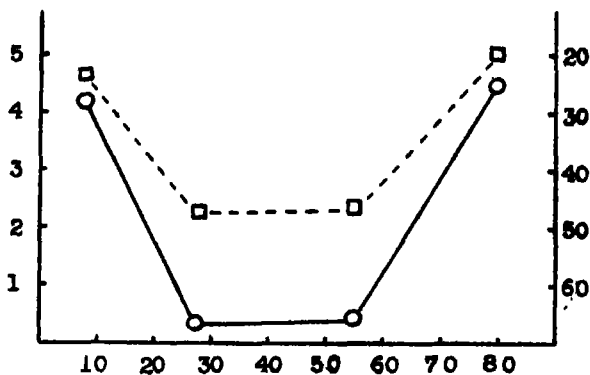


FIG. 1. Graph showing changes in oxygen consumption (squares, connected with broken line) and in substrate-dehydrogenase activity (circles, connected with full line) during metamorphosis. Abscissa: pupal age in hours. Ordinate (left): oxygen consumption in cmm per hour, per 1 mg dry weight. Ordinate (right): time in minutes, necessary to decolorize 0.2 ccm 0.02 per cent. methylene blue, containing 10 pupae.

The results can not be due to exhaustion of hydrogen-donor substances in the pupae in stages II and III. The addition of potassium succinate (0.4 per cent.), as extra donor, to the reaction mixture does not alter the results, and the differences between the four stages

<sup>1</sup> J. H. Bodine and P. R. Orr, *Biol. Bull. Woods Hole*, 48: 1, 1925.

<sup>2</sup> M. R. Clare, *Biol. Bull. Woods Hole*, 49: 440, 1925.

<sup>3</sup> D. F. Poulson, *Zeits. vergl. Physiol.*, 22: 466, 1935.

<sup>4</sup> Th. Dobzhansky and D. F. Poulson, *Zeits. vergl. Physiol.*, 22: 473, 1935.

<sup>5</sup> A. Wolsky, *Jour. Exp. Biol.*, 15: 225, 1938.

<sup>6</sup> D. M. Needham, *Biol. Rev.*, 4: 305, 1929.

<sup>7</sup> V. B. Wigglesworth, "Insect Physiology." London: Methuen, 1934.

<sup>8</sup> A. Wolsky, *Jour. Exp. Biol.*, 15: 232-233, 1938.

<sup>9</sup> H. Schwan, *Ark. Zool.*, 32: 1, 1940.

<sup>10</sup> T. Thunberg, *Quart. Rev. Biol.*, 5: 318, 1930.

remain unchanged. This means that the dehydrogenase system is saturated with substrate during the whole period of metamorphosis. From the experiments reported here, it is clear that the substrate dehydrogenase system of *Drosophila* pupae undergoes quantitative changes during metamorphosis, which run parallel with those observed earlier in the oxygen-transferring system and which are manifested in the oxygen consumption of the pupae in different stages.

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### OZONIZATION OF *o*-XYLENE AND 1,2,4-TRIMETHYLBENZENE<sup>1</sup>

LEVINE and Cole<sup>2</sup> found that *o*-xylene on ozonization affords products evidently arising from both of the two possible Kekulé forms of the hydrocarbon, but they presented no data concerning the yields of the three substances which they isolated. A reinvestigation of this reaction in our laboratory from the analytical point of view has been completed and will be described in detail in a paper which is being prepared for publication in the *Recueil des Travaux Chimiques des Pays-Bas*. As noted in a preliminary report of some of the experiments,<sup>3</sup> our method of following the course of the reaction consists in converting the products of ozonization into the oximes and determining the composition of the oxime mixture by a special analytical method.

If each of the two Kekulé forms contributes 50 per cent. to the structure of *o*-xylene, there should be formed 1 mole of dimethylglyoxal, 2 moles of methylglyoxal and 3 moles of glyoxal from 2 moles of *o*-xylene. We have transformed these decomposition

products into the corresponding oximes and obtained the total oxime mixture in yields of from 20 to 25 per cent. of the theoretical amount calculated on *o*-xylene. The above theoretical ratio of the free carbonyl compounds would correspond to an oxime mixture of the following composition: dimethylglyoxime, 20 per cent.; methylglyoxime, 35 per cent.; glyoxime, 44 per cent. As a mean of six ozonization experiments, we found the ratio: dimethylglyoxime, 20.7 per cent.; methylglyoxal, 34.2 per cent.; glyoxime, 44 per cent. The accordance with the theoretical values seems better than it actually is, because the separate experiments show deviations of from 3 to 7 per cent. from the theoretical values. Considering the experimental difficulties, the accordance between experiment and theory is satisfying.

We have also investigated the ozonization of 1,2,4-trimethylbenzene. In this case, if the two resonating Kekulé forms each contribute 50 per cent. to the structure of the hydrocarbon, 2 moles of 1,2,4-trimethylbenzene should provide 1 mole of dimethylglyoxal, 4 moles of methylglyoxal and 1 mole of glyoxal, and the composition of the mixture of oximes should be: dimethylglyoxime, 18.9 per cent.; methylglyoxime, 66.7 per cent.; glyoxime, 14.4 per cent. As a mean of two ozonization experiments, we found the following percentages: dimethylglyoxime, 17.9 per cent.; methylglyoxime, 66.2 per cent.; glyoxime, 14.2 per cent. The accordance with the theoretical ratio is very good. In this case the quantity of oximes recovered amounted to 15 per cent. of the theoretical yield.

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## SCIENTIFIC APPARATUS AND LABORATORY METHODS

### PRESERVATION OF BIOLOGICAL SPECIMENS WITH ISOBUTYL METHACRYLATE POLYMER

DURING the last few years several articles have been published describing various methods of preserving biological material by the methacrylate resins. Dr. J. H. Hibben<sup>1</sup> described a method of allowing the plas-

tic to polymerize around the object to be preserved. Dr. H. G. Knight<sup>2</sup> called attention to the expense and difficulties of this method and Professor E. C. Cole<sup>3</sup> mentioned the possibility of imbedding objects in a solution of methyl methacrylate polymer dissolved in chloroform, but stated that he did not get satisfactory results.

Some months ago while attempting to preserve the color patterns of *Chorthippus longicornis* for genetic studies, the writer tried dipping the grasshoppers in a solution of isobutyl methacrylate polymer dissolved in toluene. The grasshoppers were first injected with various preservatives, pinned and then dipped in a solution containing 10 gm of the polymer to 100 cc of toluene, and allowed to dry. By repeated dippings

<sup>1</sup> This communication is constructed from data sent to me by Professor J. P. Wibaut in a letter of February 24, 1941, with the request that I arrange for its publication in SCIENCE. Professor Wibaut states, "I would appreciate very much if our results could be made available to American scientists in this way, as it may take some time before our complete paper will be published and even then it may not be available to the chemists in your country."—L. F. Fieser, Harvard University.

<sup>2</sup> A. A. Levine and A. G. Cole, *Jour. Am. Chem. Soc.*, 54: 338, 1932.

<sup>3</sup> J. P. Wibaut and P. W. Haayman, *Nature*, 144: 290, 1939.

<sup>1</sup> J. H. Hibben, *SCIENCE*, 86: 247-248, 1937.

<sup>2</sup> H. G. Knight, *SCIENCE*, 86: 333-334, 1937.

<sup>3</sup> E. C. Cole, *SCIENCE*, 87: 398-398, 1938.

a coat approximately 1/16 of an inch thick was placed on the insects. When the abdomen was injected with 2 per cent. formaldehyde there was a slight fading, but recently, at the suggestion of Dr. C. E. McClung, ordinary white Karo syrup has been injected into the abdomen and so far there has been no fading. Every color is life-like and natural. As the methacrylate resin dries, however, there is a slight shrinkage. Wings of grasshoppers may be pinned out and painted with the resinous solution, adding successive coats until the desired thickness is obtained. Each coat must be thoroughly dry before the next coat is applied or the succeeding coat will soften the previous coat and allow the wing to fold. The wings may be allowed to dry for two or three days in a stretched position and then painted or they may be painted immediately after stretching if due care is taken to prevent the wings from being cemented to the stretching board or pins. In order to do this, best results were obtained by painting the dorsum of the body and the medial halves of the superior surfaces of the wings, allowing these areas to dry and then painting the lateral halves of the superior surfaces. After that coat was dry the ventral surfaces of the body and wings were painted. Then alternate coats were applied to the dorsal and ventral surfaces until they had a coating about one sixteenth of an inch thick.

Butterflies have been preserved in this manner. Except for the fact that the opaque scales are rendered translucent, the color pattern is preserved perfectly, and they may be examined with almost complete disregard for their fragility; in fact, several of the butterflies have been worn as ornaments, their glass-like finish giving them the appearance of imitations.

Frogs up to six inches in length have been preserved by dipping them in the resinous solution. Best results have been obtained by injecting the coelomic spaces and the muscles of the thigh and calf of the frog with a solution of sodium benzoate (one part saturated solution of sodium benzoate to three parts distilled water), then soaking them for fifteen minutes in a 2 per cent. formaldehyde solution before dipping them in the methacrylate solution. If the frogs are alternately dipped and dried until they have a coating from one sixteenth to one eighth of an inch thick there is no appreciable shrinkage. Good results have also been obtained by using 2 per cent. formaldehyde for injection purposes.

Each particular kind of material has to be treated in a manner suitable for its own needs. Leaves dried under pressure for two days and then dipped in this plastic solution have kept their color without distortion. Furthermore, fragile bones soaked in a solution of isobutyl methacrylate polymer have been strength-

ened until they can be handled without undue danger of damage.

M. D. WHEATLEY

THE STATE UNIVERSITY OF IOWA

### A SIMPLE IMPROVEMENT IN THE FROG WEB CIRCULATION DEMONSTRATION

So often is the demonstration of the circulation in the web of the frog's foot used in biology classes that a simple improvement in the usual technique is worthy of mention here.

Recently we found it necessary to take photomicrographs of the melanophores in the frog web to record changes in size and shape. In order to produce a plane field such that the edges of the preparation would be in focus simultaneously with the center the idea was conceived of using a small plate of glass placed under the web between two toes. An ordinary microscope slide was cut into triangles, the apices of which were angles varying from 40° to 60°. By cutting diagonally across the slide these triangles had an altitude of one inch. The sharp edges were then rubbed smooth on a piece of emery cloth.

After the frog's toes were spread apart in the usual manner across an opening in the frog board a glass triangle was slipped between two toes and under the web. The glass triangle adheres tightly to the lower surface of the web once it comes in contact with it and the result is a plane surface which lends itself ideally for microscopic observation. Photomicrographs can be made of an area of the web with the entire optical field in focus. Observations of the blood flow are greatly improved. Also it has been found that the web does not become too dry if left in this condition for at least an hour which obviates adding water to the surface which in turn changes the focus of the microscope.

The simple addition of a glass triangle (which is very easily made) so improves the aspect of the web circulation that it is well worth trying by any one having to set up such a preparation.

WM. A. HIESTAND

PURDUE UNIVERSITY

### BOOKS RECEIVED

- BRANSON, E. B. and W. A. TARR. *Introduction to Geology*. Second edition. Pp. ix + 482. 447 figures. McGraw-Hill. \$3.75.
- CROSS, J. C. *An Introduction to Biology*. Pp. xviii + 507. 331 figures. Mosby. \$1.90.
- HOGG, JOHN C. and CHARLES L. BICKEL. *Elementary General Chemistry*. Pp. ix + 603. Illustrated. Van Nostrand. \$2.12.
- LYNN, ELDIN V. *Organic Chemistry; with Applications to Pharmacy and Medicine*. Pp. 410. Lea and Febiger. \$4.50.
- QUINE, WILLARD V. O. *Elementary Logic*. Pp. vi + 170. Ginn. \$2.25.
- TURNER, O. E. and ELIZABETH MCHOSE. *Effective Living*. Pp. x + 432. 164 figures. Mosby. \$1.90.

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## THE DURHAM MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Edited by Dr. F. R. MOULTON

PERMANENT SECRETARY

FROM June 23 to June 28 the American Association for the Advancement of Science held its one hundred eighth meeting at Durham, N. H., in connection with the celebration of the seventy-fifth anniversary of the founding of the University of New Hampshire. All the scientific sessions were held in the university buildings, which were conveniently located and excellently equipped. Most of the persons attending the meeting secured sleeping accommodations in the dormitories of the university. The special committees on arrangements were members of the university staff. At the close of the general session on the first evening the university tendered a reception to the association and its guests, and on the fourth evening

the university entertained the scientists with a concert at which Haydn's oratorio, "The Creation," was rendered by the New Hampshire Youth Orchestra under the direction of Professor Bjornar Bergethon. To an exceptional degree the university was an efficient and gracious host to the association.

At the Durham meeting six sections and twenty-one affiliated and associated societies presented programs or participated in joint programs. In addition to two general sessions of the association, the sections and participating societies held 49 sessions at which 210 formal papers were presented. Besides these formal sessions, there were several round-table discussions, eleven luncheons and dinners at most of

which addresses were delivered, thirty-four tours and excursions for scientific purposes, five demonstrations and exhibits and exhibitions of one or more of nineteen motion pictures on scientific subjects every afternoon during the meeting. Since nearly every room used for scientific sessions had to be provided with screens, projection apparatus and operators, and since precise arrangements had to be made for every luncheon, exhibit, dinner, demonstration and excursion, the duties of the local committee were heavy. Under the general chairmanship of W. C. O'Kane, Harry West was in charge of providing lanterns and screens, John C. Rowell looked after housing on the campus and in hotels of neighboring towns, J. T. Kangas assisted the press in obtaining material for reports of the meeting for the daily papers, Samuel Stevens arranged for transportation, Marion Beckwith supervised preparations for recreation and entertainment and E. H. Stolworthy cared for the exhibits.

### REGISTRATION

It is estimated that about 1,000 persons attended one or more sessions of the meeting, of whom 322 registered and received copies of the general program, a book of 60 pages. The general program not only contains the details of every session but is a condensed summary of the activities of the meeting which is often useful for future reference. After meetings of the association have adjourned the office of the permanent secretary supplies to members, free of charge, copies of the general programs, upon request, until they are exhausted.

The distribution by states of the registrants at the Durham meeting was as follows: California, 1; Colorado, 1; Connecticut, 23; Delaware, 2; District of Columbia, 13; Florida, 2; Illinois, 6; Indiana, 3; Iowa, 1; Kansas, 2; Maine, 19; Maryland, 6; Massachusetts, 70; Michigan, 7; Minnesota, 1; Montana, 1; Nebraska, 1; New Hampshire, 34; New Jersey, 11; New York, 46; North Carolina, 1; Ohio, 9; Pennsylvania, 23; Rhode Island, 8; South Carolina, 1; Vermont, 23, and Wisconsin, 1. In addition, there were 6 registrants from Canada, making a total registration of 322.

### SCIENTIFIC SESSIONS

#### SECTION ON MATHEMATICS (A)

(From report by T. R. Hollcroft, secretary pro tem.)

The section held two sessions, at each of which two papers were presented, followed by discussions. At the first session, H. L. Slobin, presiding, Norbert Wiener delivered an address on "Statistical Mechanics," in which he presented results achieved jointly by himself and Aurel Wintner. He explained a means of deducing a measure in the space of distribution of

points, such as the molecules of a gas, from density functions of  $n$ -ads of such particles. The second address at the first session, by Deane Montgomery on "Topological Transformation Groups in Euclidean Spaces," was a summary of recent results on finite groups of homeomorphisms obtained by Neuman and Smith and on transformation groups by Montgomery and Zippin.

At the second session, C. R. Adams presiding, Garrett Birkhoff delivered an address on "Vector Lattices," in which he used order in place of distance in defining the properties of function spaces, at least for the notions of boundedness, completeness, convergence, linear transformations and conjugate spaces. The final paper of the program of the section was by D. C. Lewis, Jr., on "Some Recent Researches on the Coloring of Maps." The number of ways a map can be colored in  $\lambda$  colors is a polynomial in  $\lambda$  called the *chromatic polynomial* associated with the map. It was shown that there are more appropriate methods of studying chromatic polynomials than the Kempe chain method, and that the Kempe chain method may be modified so as to give quantitative, as well as qualitative, results.

#### AMERICAN METEOROLOGICAL SOCIETY

(From report by Charles F. Brooks, secretary)

At the two sessions of the society on Wednesday, June 25, twelve papers were presented which together constituted a fairly complete discussion of the climate of New England in all its phases. A number of new studies were presented, including work being carried out on Mount Washington. Papers were presented by D. L. Arenberg, H. I. Baldwin, A. C. Bemis, A. E. Bent, C. F. Brooks, D. H. Chapman, J. H. Conover, V. A. Conrad, K. O. Lange and E. Sable. The society conducted an excursion to the summit of Mount Washington to visit the meteorological observatory maintained there. Attendance, 40.

#### SECTION ON GEOLOGY AND GEOGRAPHY (E) AND GEOLOGICAL SOCIETY OF AMERICA

(From report by Allyn C. Swinnerton, secretary)

The section and the society held three joint sessions for the presentation of twenty-five papers and conducted two field excursions. The program was organized by Howard A. Meyerhoff, retiring secretary of the section, and W. Elmer Ekblaw, representing the Association of American Geographers. The University of New Hampshire, through its department of geology, joined in sponsoring both the sessions for presenting papers and the field excursions. About 140 persons attended the sessions or participated in the excursions.

On Monday afternoon, June 23, nine papers were

presented on the "Bed-Rock Geology of Northern New England," ranging geographically from Maine to Vermont and from the Canadian border to northern Massachusetts. Three of the papers were preparatory for the White Mountains excursion.

On Tuesday morning seven papers dealt with "Recent Glacial Research in New England," and with recent coastal changes. The Tuesday afternoon sequence of papers presented the many sides of New England's geographic problems from mineral resources to recreational facilities, from soil conservation and grassland *vs.* forest economy to village planning.

On Wednesday a party of 54, under the leadership of G. W. White, A. S. Carlson, D. H. Chapman and J. W. Goldthwait, examined the geographic and glacial features of the Cochecho valley, the coastal lowland and the shore features in the vicinity of Durham. Considerable discussion was provoked on the subjects of the building of the kame terraces and the nature of the glacial recession.

A cavalcade of 22 automobiles, carrying over 60 persons, left Durham on Thursday morning to begin a three-day geological excursion through the White Mountains. The ring-dike structures of the Belknap and Ossipee Mountains were examined on the first day under the direction of M. P. Billings and A. W. Quinn. On Friday the party ascended Mount Washington. During the day R. P. Goldthwait pointed out the glacial features, and under Billings's direction the mountain-forming Littleton schist was examined. Later in the day the rocks on the east and north sides of Mt. Washington were studied. On Saturday, under the direction of C. A. Chapman and Katharine Fowler-Billings and with the assistance of R. W. Chapman, the party, still numbering over 50, investigated the Ordovician and later meta-sediments and the dome structures of the Oliverian magma series on the western flank of the White Mountains. A worthwhile feature of the excursion was the informal conferences on Thursday and Friday evenings, at which the discussions ranged from the mechanics of intrusion of ring-dikes and magma sheets and domes to the deformation and metamorphism of the rocks of the White Mountains.

The three-day excursion afforded an opportunity to view systematically and intelligently one of the most complicated mountain structures in the world, and the large party expressed unanimous and enthusiastic approval of the tour. The success of the field trip can be attributed largely to the careful planning of the geological itinerary by M. P. Billings and to the arrangements for accommodations made by G. W. White.

#### AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

(From report by Ernest N. Cary, secretary)

The society presented a symposium on "Laboratory Procedures in Studies of the Chemical Control of Insects" in four sessions on Wednesday and Thursday, June 25-26, at which eleven formal papers were presented, each paper being followed by formal and informal discussions. The first paper of the symposium was an introduction of its whole subject by W. C. O'Kane, followed by discussions of three topics on "Rearing Test Insects," the leaders of which were H. A. Waters, H. H. Shepard and F. L. Campbell. The second session consisted of discussions of "Stomach Insecticides" and "Contact Insecticides, including Ovicides," the leaders of which were Roy Hansbury and C. H. Richardson. For the third session the subjects were "Fumigants" and "Aerosols." The leader of the discussions of the former of these subjects was R. T. Cotton; the leaders for the latter were L. D. Goodhue and W. N. Sullivan. The subjects for the final session were "Fabric Protectors," "Attractants and Repellants" and "Termite Soil Poisons." The leaders of the discussions of these subjects were, respectively, F. W. Fletcher, V. G. Dether and W. E. McCauley. Attendance, about 130.

#### BOTANICAL SOCIETY OF AMERICA

On Tuesday evening, June 24, the systematic section of the society held a joint session with the American Society of Plant Taxonomists for a round-table discussion of "The Floras of Northeastern North America" under the leadership of W. H. Camp. On Wednesday afternoon the physiological section of the society joined with the American Society of Plant Physiologists in a round-table discussion of "Auxins and their Relation to Growth in Plants." The leaders in the discussions were Kenneth V. Thimann, Folke K. Skoog and George S. Avery, Jr. On Wednesday the societies joined with other societies in a dinner for all botanists.

#### AMERICAN PHYTOPATHOLOGICAL SOCIETY

(From report by Frank L. Howard, secretary)

The society held ten sessions, three for the presentation of formal papers and the remainder for tours and inspections of laboratories and experiment stations. The meeting of the society began on Tuesday, June 24, with a visit to Bartlett Tree Research Laboratories, Stamford, Conn., with a program which consisted partly of papers and partly of demonstrations, followed by a complimentary dinner by the Bartlett Company. On Tuesday afternoon the society made a tour of Yale University. In the evening the

Connecticut Agricultural Experiment Station in New Haven held open house, under the leadership of J. G. Horsfall, to the society and its guests. After an address of welcome by W. L. Slate the new greenhouses and their equipment and work were exhibited.

On Wednesday morning the society divided into two sections, the first of which made a tour of the Forest Pathology Laboratory of the U. S. Department of Agriculture, the Yale Forestry School, an example of forest fire damage, and the researches of A. H. Graves on chestnut blight. The second section inspected chemotherapy for Dutch elm disease, organic fungicides for apple scab, and a new type of power duster at the Experiment Station Farm at Mt. Carmel, Conn. After a luncheon at Sleeping Giant State Park, the society, under the leadership of P. J. Anderson, made a tour of the Tobacco and Vegetable Substation at Windsor, Conn., and examined demonstration plots for control of cabbage club root. The evening was devoted to a business meeting of the society, a session for the presentation of short papers and a discussion of tobacco diseases and insects.

On Thursday morning the society made a tour through shade tobacco fields of Windsor, Conn., and vicinity, after which it proceeded to Waltham, Mass., where it had luncheon in the perennial garden of the Field Station. The afternoon was spent, under the leadership of E. F. Guba, in inspecting gardens and witnessing demonstrations of means of controlling various plant diseases, after which the society drove to Durham, N. H. On Friday the society joined with the horticulturists in inspecting the laboratories and greenhouses of the departments of botany and horticulture of the University of New Hampshire and in a field trip to the horticultural farm. Attendance, from 20 to 130.

Officers of the New England Division of the society were elected as follows: *President*, B. F. Lutman; *Vice-President*, Emil F. Guba; *Secretary-Treasurer*, M. C. Richards; *Councilor*, Frank L. Howard.

#### AMERICAN SOCIETY OF PLANT PHYSIOLOGISTS

The society participated in the dinner for all botanists on Wednesday evening, June 25, and on Thursday held two sessions, the second of which was a joint session with Horticulturists of New England and Eastern Canada. A business meeting of the society was held at the beginning of the morning session, after which six papers on various subjects were presented. The afternoon program consisted of six papers.

#### TORREY BOTANICAL CLUB

(From report by John A. Small, chairman of field committee)

The program of the society consisted entirely of

field trips beginning on Sunday morning, June 22, and closing on Friday, July 4. On the morning of the first day about 75 members of the society ascended Mt. Monadnock and in the afternoon, under the guidance of H. I. Baldwin, visited the Caroline A. Fox Research and Demonstration Forest at Hillsboro, N. H. On Monday afternoon the society joined with the Ecological Society of America, under the leadership of C. F. Jackson and Albion Hodgdon, in a trip to Spruce Hole and Cedar Swamp. On Tuesday the same societies joined under the same leadership in a trip for the study of York County (Maine) flora. On Wednesday the societies took a trip through the White Mountains and on Thursday they ascended Mount Washington, holding en route an informal symposium on the ecology on an alpine zone (report of Ecological Society of America). After spending Friday in further exploration of the Mount Washington region, the society transferred its activities to Maine for seven days, during which it visited a sporting camp and camping grounds in Maine woods, ascended Mt. Katahdin and continued to Eastport and examined the raised bogs and coast vegetation of Washington County. The Maine tour, under the leadership of F. H. Steinmetz and his colleagues of the University of Maine, closed on July 4 with a visit to Mt. Desert Island and Acadia National Park.

#### AMERICAN SOCIETY OF PLANT TAXONOMISTS

On Tuesday evening, June 24, the society held a joint session with the Botanical Society of America and participated in the field trips of the Torrey Botanical Club, which are reported above.

#### AMERICAN FERN SOCIETY AND SULLIVANT MOSS SOCIETY

The societies participated in the field trips of the Torrey Botanical Club.

#### NEW ENGLAND BOTANICAL CLUB

The society held field meetings on Thursday and Friday, June 26-27, under the leadership of A. R. Hodgdon. The region visited was the western part of Strafford County, N. H., and the adjacent parts of Merrimack County.

#### ECOLOGICAL SOCIETY OF AMERICA

(From report by W. J. Hamilton, Jr., secretary)

The society participated in the field trips of the Torrey Botanical Club and organized a symposium on "Mount Washington (alpine) Ecology," consisting of a paper on "Weather and Climate" by Charles F. Brooks, a paper on "Glacial Geology" by Richard F. Goldthwait, two papers on alpine flora by Stuart R. Harris and A. J. Grant and three papers on alpine fauna by C. F. Jackson, Maurice Provost and C. P.

Alexander. The last paper on the program was "Mountaineering Photography," by H. Bradford Washburn. Attendance, 58.

#### NATIONAL ASSOCIATION OF BIOLOGY TEACHERS

(From report by Fletcher J. Proctor, program chairman)

On Wednesday, June 25, the society held two sessions at which seven papers were presented. In addition to papers on the content of courses in biology and methods of teaching, Charles J. Lyons, of Dartmouth College, presented a paper on "Some Old New England Diaries (Tree Rings)," and C. C. Little, of Jackson Memorial Laboratory, presented one on "Cancer." About 70 persons attended the sessions of the society.

#### SECTION ON PSYCHOLOGY (I)

(From report by E. G. Ekdahl, secretary pro tem.)

The section held two sessions on Thursday, June 26, at which seven papers were presented, with an attendance of about 45 persons. A paper on "German Military Psychology and Recent Trends in American Psychology," by H. L. Ansbacher, and another on "Dynamic Factor in Nationalism," by Ross Stagner, attracted exceptional attention. An important paper on an entirely different type of subject was "Stronger Relation between Adaptation and Intensity in After Images of the Control Area of the Retina," by Theodore Karkowski. The audience was fascinated by the reading of a paper by Michael J. Supa from a manuscript written in Braille. Other papers were presented by Clarence Young, Harold Schlosberg and Howard Kingsley. The opportunities for full presentation of papers and discussions of them afforded by a program not crowded by many papers were greatly appreciated.

#### SECTION ON SOCIAL AND ECONOMIC SCIENCES (K)

(From report by George A. Lundberg, secretary pro tem.)

Beginning on Tuesday morning, June 24, the section held two sessions on each of three successive days before which twenty-eight papers were presented. The general subject for the first two sessions was "The Second Colonization of New England." The papers in these two sessions, C. C. Zimmerman and A. M. Myhrman, *chairmen*, were devoted to such subjects as the Irish, the French Canadians and the Italians in New England, and the social, economic and ecologic problems connected with the arrival of these peoples. The speakers were Allen R. Foley, William R. Gordon, George C. Homans, Charles P. Loomis, A. M. Myhrman and John A. Rademacker, A. J. Newman, Irene B. Taeuber, Nathan L. Whetten, W. E. Whyte

and C. C. Zimmerman. The general subject of the third session was "Ecological and Demographic Aspects of the New England Area," which was discussed by Stanley D. Dodge, Samuel Koenig and Conrad Arensberg. George A. Lundberg was chairman.

The fourth session, Charles W. Coulter, *chairman*, was devoted to five papers on "Social Organization and Public Policy," the speakers being Philip M. Marston, Errol C. Perry, Thorsten V. Kalijarvi, Lashley G. Harvey and Edgar C. McVoy. The general subject of the fifth session was "Typical Problems of the New England Area; People and Resources," on which papers were presented by D. C. Babcock, Ruth J. Woodruff, Harry W. Smith, J. C. Blum and J. E. Bachelder. The final session, with George A. Lundberg *chairman*, considered "Social Welfare in New England" in papers by Charles Chakerian, Walter McKain and Lincoln Fairley. About 50 persons attended the sessions of the section. On Thursday evening the section held a joint dinner with the American Society of Agronomy at which H. H. Bennett, chief of U. S. Soil Conservation Service, delivered an address on "Soil Conservation in the Northeast."

#### THE NATIONAL SOCIAL SCIENCE HONOR SOCIETY, PI GAMMA MU

The society held a luncheon on Tuesday, June 24, at which brief addresses were delivered by S. Howard Patterson, president of the society, LeRoy Allen, secretary, and Governor Blood of New Hampshire. The society sponsored a general session of the association in the evening at which F. R. Moulton delivered an address on "Our Social Order." S. Howard Patterson presided and introduced the speaker. Attendance, about 225.

#### SECTION ON MEDICAL SCIENCES (N)

(From the report of Malcolm H. Soule, secretary)

The section held two sessions on Tuesday, June 24, at which twenty-one papers were presented, of which more than half were contributions by members of the faculty of the University of Vermont College of Medicine. Several papers were in important fields of experimental medicine, such as the tolerance of sugar by human subjects after different administrations of glucose, the effect of cystine on human milk production and the influence of glucose on the absorption and toxicity of sulfapyridine. Others involved experiments with lower animals. Two papers were on heart diseases. Several were concerned with infections and the germicidal efficacy of certain compounds. One was on neuro-muscular mechanisms in skeletal muscle contractions. The variety and importance of the subjects discussed were so great that the programs of the section attracted an audience of 97 persons.

## AMERICAN DIETETIC ASSOCIATION

(From report by Beula B. Marble, program chairman)

The society held two sessions on Thursday, June 26, at which six papers were presented. The audiences of 125 and 150, respectively, were drawn from every one of the New England states and included representation of at least twenty professional and related groups, such as dietetic and home economics associations and public health, nursing, pediatric and educational agencies. Miss Mary E. Foley presided at the first session, Miss Helen F. McLaughlin at the luncheon and Miss Dorothy Duckles at the second session.

## AMERICAN PSYCHIATRIC ASSOCIATION

(From report by Arthur H. Ruggles, chairman)

On Thursday, June 26, the society presented a symposium on "The Psychiatric Aspects of Civilian Morale" under the chairmanship of Arthur H. Ruggles. The five papers on the program discussed psychiatric aspects of civilian morale as related to children, the aged, industry, the community and the general public. The contributors were Douglas A. Thom, A. Warren Stearns, Lydia G. Giberson, George K. Pratt and Samuel W. Hamilton. The attendance was about 30.

## AMERICAN SOCIETY OF AGRONOMY, NORTHEASTERN SECTION

(From report by Ralph W. Donaldson, secretary-treasurer)

The society held a regional grassland conference beginning on Wednesday morning, June 25, and continuing until Friday afternoon, with an attendance of about 100. The program consisted of three sessions for the presentation of papers, four field trips and a joint dinner with the Section on Social and Economic Sciences, at which H. H. Bennett delivered an address on "Soil Conservation in the Northeast." At the first formal session, Dr. Fred Engelhardt, president of the University of New Hampshire, delivered an address of welcome, which was followed by three scientific papers. Six papers were presented at each of the two following sessions. The field trips were to the grass nursery on the O'Kane farm, the Angell farm, Chesley pasture, the farm of Frances Peaslee, Northwood Ridge, the Livingston farm and the R. N. Johnson farm, at each of which the results of experiments in grassland farming were exhibited. About 80 persons participated in these field trips.

## SOCIETY OF AMERICAN FORESTERS

(From report by Henry Clepper, secretary)

Beginning on Tuesday morning, June 24, the so-

cietiy held six sessions at which twenty-seven papers were presented and which were attended by about 140 persons. The formal program consisted of four symposia: "Forest Insects and Diseases," presented in two sessions under the chairmanship of H. B. Peirson; "Forest Fire Control," presented in two sessions under the chairmanship of Austin Wilkins; "Forestry and National Defense," presented in one half-day session under the chairmanship of John H. Foster, and "Forestry and Rural Economy," presented in one half-day session under the chairmanship of Clifford Graham. The society held a business meeting and dinner at Hampton Beach, N. H., on June 25, under the chairmanship of C. S. Herr, at which Henry Schmitz was the speaker. On June 26 about 75 members and guests of the society took a field trip to the Manchester (N. H.) waterworks forest. One of the interesting events of the meeting was a demonstration by the U. S. Bureau of Entomology and Plant Quarantine of dusting for the control of the gypsy moth with the autogiro.

## HORTICULTURISTS OF NEW ENGLAND AND EASTERN CANADA

(From report by A. F. Yeager, secretary pro tem.)

On Thursday morning, June 26, the horticulturists met in three sections for a round-table discussion on "Body Stocks of Apple Trees," led by J. N. Waring; a round-table discussion on "Experimental Work in Floriculture," led by H. E. White, and a conference on "Home Vegetable Gardens in New England," led by J. R. Hepler. The society held one joint session with the American Society of Plant Physiologists, visited the University of New Hampshire greenhouses and field plots with the American Phytopathological Society and visited neighboring commercial orchards, vegetable areas, the carnation breeding house of Mr. Sims and other points of interest.

## SOCIETY OF SIGMA XI

(From report by George A. Baitzell, secretary)

The society held a luncheon on Thursday, June 26, which was attended by about 25 members. Brief addresses were delivered by Edward Ellery, president of the society, and George A. Baitzell.

## HONOR SOCIETY OF PHI KAPPA PHI

The society sponsored a general session of the association on Wednesday evening, June 26, at which Max Schoen delivered an address on "The Basis for Faith in Democracy." Lawrence R. Guild, secretary of the society, presided and introduced Dr. Schoen. The attendance was about 225.

## THE ASKOY EXPEDITION OF THE AMERICAN MUSEUM OF NATURAL HISTORY IN THE EASTERN TROPICAL PACIFIC

By Dr. ROBERT CUSHMAN MURPHY

AMERICAN MUSEUM OF NATURAL HISTORY

BETWEEN February 9 and May 26, 1941, an American Museum party operated the steel Diesel schooner *Askoy* in the area between the Gulfs of Panama and Guayaquil, and from the American coast to a meridian three hundred miles west of Point Chirambirá. The field of investigation thus included the shorelines of southern Darien, Pacific Colombia and Ecuador, such coastal or oceanic islands as the Perlas Archipelago, Gorgona, La Plata and Malpelo, and the outlying pelagic waters. From the points of view of geographer, oceanographer and marine biologist, the region offered a little-worked and fruitful field. A six-hundred-mile stretch of this part of Central and South America, for example, still ranks as the world's least known continental seacoast, while the adjacent bight of the equatorial Pacific has been only sporadically the scene of modern oceanic research.

During a cruise of approximately four thousand miles, investigations were conducted at well over a hundred precisely fixed stations. Some of these were distributed in series parallel with the shore and others at right angles, or across the course of the northward-flowing coastal current. Six of the latter transects were carried for distances of from fifty to three hundred miles offshore. On the southernmost of the sections, toward the west from Point Santa Elena, Ecuador, the most northerly line of stations worked by the British research ship *William Scoresby*, in 1931, was repeated. To this extent the campaign of *Askoy* was linked up with an earlier extensive survey in the ocean off Peru and Chile.

Routine procedure at the stations related chiefly to the surface layers, down to a depth of 150 meters. It included meteorological observations, surface temperatures, vertical temperature sections with the bathythermograph, sea-water samples from selected levels and quantitative catches made with Clarke plankton-samplers. The latter recently devised instruments automatically record the volume of water that passes through the nets, thus obviating the calculations formerly based upon net-diameter, speed and length of haul, etc. It is believed that on this expedition the Spilhaus bathythermograph received its first use in the Pacific Ocean. By working a thermometric element against a pressure element, this device traces on a smoked glass slide a graph which can be readily calibrated to indicate temperatures at all depths within its range. Since the plottings show

the thermoclines, they are immediately available as a guide to the most significant levels for taking salinity samples and plankton.

Less regular observations comprised phytoplankton hauls, direct surface current measurements at stations where the vessel could be anchored with hydrographic cable, temperature records obtained with reversing thermometers and soundings by means of wire or Kelvin tubes. (The fathometer with which *Askoy* was alleged to be equipped proved, unfortunately, to be in complete disrepair, a fact likewise true of much other gear guaranteed by the charter specifications). Dredging was carried out in many bays and estuaries, as well as on parts of the open continental shelf. Furthermore, the Dunn diving helmet was employed in the shore waters of numerous mainland and insular localities, particularly at sites of previously unreported reef-coral formations.

The planning and leadership of the expedition were entrusted to Dr. Robert Cushman Murphy, who in 1937 had made a preliminary reconnaissance in the same area. Dr. John C. Armstrong, of the museum's Department of Living Invertebrates, served as scientific associate, and José G. Correia as preparator. The crew comprised Captain Halford Connolly as sailing master, Robert François as mate and Oscar Paar as engineer. Between March 20 and the end of the field work, Lieutenant Eduardo Fallon, commander of the gunboat *Junin* and ranking Colombian naval officer on the Pacific coast of his country, was also a member of *Askoy's* contingent. Because of his intimate knowledge of a hazardous and poorly charted coast, his skill as a navigator, and his able share in every aspect of the investigations, Lieutenant Fallon's participation was a happy and invaluable asset. In early April the American Museum sent Mrs. Murphy by air as a courier to the expedition, with which she remained for a week along the coast of Ecuador.

The four months' use of *Askoy* was made possible by the interest and liberality of several individuals and organizations. Funds to cover the charter of the schooner and the purchase of certain costly equipment were given by Jesse Metcalf, who subsequently flew to Buenaventura and joined briefly in field work at the Bay of Málaga. Contributions, in part unsolicited, were made by the following additional

friends of the museum: Mrs. George Blumenthal, Mrs. Edward F. Dwight, Mr. and Mrs. Ward Malville, Messrs. Frederick F. Brewster, Guy Emerson, Edgar J. Marston, E. Hope Norton, Duncan H. Read and Henry D. Sharpe. Carl Tucker provided a motion picture camera and a supply of 16-mm Kodachrome film.

The Woods Hole Oceanographic Institution lent much apparatus, including two bathythermographs, which would have been otherwise unobtainable. The Hydrographic Office of the United States Navy and the Coast and Geodetic Survey furnished essential scientific and navigational equipment as well as credentials and other aid. The Governments of the Republics of Panama, Colombia and Ecuador, through the good offices of their respective embassies at Washington, and the executives of the Panama Canal Zone all offered their patronage and granted facilities and privileges in part unprecedented. Particularly generous and effective was the cooperation of the Colombian authorities, in whose national territory or zone of special interest the greater part of the period of the expedition was spent. In addition to the assignment of Lieutenant Fallon as a fellow-worker, the civil and military officials, together with numerous private citizens and foreign residents, extended hospitality and assistance at every opportunity.

Reports on the findings of the *Askoy* expedition will, of course, have to await dynamic interpretation of the statistical records and study of the collections. Most numerous among the latter are marine invertebrates of many classes, especially noteworthy being the organisms associated with coral growths. The apparent Indo-Pacific affinities of some of these will,

in the opinion of Dr. Armstrong, necessitate modification of certain currently accepted zoogeographic views.

The collection of fishes promises to be interesting, particularly because it includes a number of commensal species and a few luminescent deep-sea forms captured in plankton nets during night tows. Among other vertebrate collections are reptiles and amphibians from island and continental localities and about five hundred birds, mostly sea fowl. The distinctness of the warm-water area of convergent current movement in the tropical bight from the cool zone of divergence to the south, *i.e.*, the Humboldt Current littoral, is emphasized by the fact that the marine bird skins of the expedition include 19 species not taken during the American Museum's lengthy field work of earlier years along the coast of Peru. Incidentally, the area of *Askoy's* operations proved to be the seasonal non-breeding range of three northern-hemisphere birds of hitherto uncertain winter status, namely, the least petrel (*Halocyptena*), Sabine's gull (*Xema*) and black tern (*Chlidonias*). The stomachs of most of the sea birds were preserved, and it is hoped that their contents may be correlated with plankton and other collections so as to throw new light on the ecological chains that begin with such fundamental oceanic pasture as the diatoms.

Other data of the *Askoy* expedition are represented by field journals totaling 130,000 words, abundant photographs and colored motion picture film recording geographical and natural history subjects, oceanographic technique and the life of primitive Chocó Indians inhabiting the western watershed of the Baudó Mountains and the basin of the River San Juan.

## SCIENTIFIC EVENTS

### THE FAIRCHILD CONNECTICUT GARDEN

IN 1895 Benjamin Thomas Fairchild (1850-1939) purchased several hundred acres of land on Quaker Ridge, North Greenwich, Conn., for the purpose of carrying out a long cherished dream of establishing a wild flower sanctuary or preserve for the woody and herbaceous plants of Connecticut, and the region from Bar Harbor to the Adirondacks. He was thus a pioneer in conservation. The next forty years were spent in developing this tract by bringing in additional quantities of plants already there, and others not already on the tract. At the time of Mr. Fairchild's death, more than 400 species native to Connecticut and the more northern region had become established and listed.

In addition to the flowers the garden has an abundance of native animal life, including deer, ducks, rabbits, woodcock, pheasants, quail and grouse; it also

has many varieties of native and migrant song birds, thus serving as a bird sanctuary. A bird census of the garden, made on May 18 by Dr. Frederick H. Pough and Roger Peterson, of the National Audubon Society, resulted in the listing of eighty-two species of birds.

Mr. Fairchild was not only a nature lover, but a man of scientific training, at the head of his own chemical manufacturing firm. A trustee of New York University, he was interested in education, and it was his plan to have the Connecticut Garden serve an educational end in addition to being a plant "sanctuary." On Mr. Fairchild's death the property had a value of approximately \$127,000. In order that his wishes for the development and active use of the garden might be carried out his heirs formulated a plan to turn it over to a board of trustees for \$60,000, or less than half its appraised value.

On February 9, 1941, the Fairchild Connecticut Garden, Incorporated, a non-profit educational corporation, was formed, which has acquired title to 127.49 acres of the garden, the portion of greatest floristic and ecological value. It is planned to make it a center of educational work for nature study and related subjects.

The trustees of the Fairchild Connecticut Garden, Inc., are as follows: B. Tappen Fairchild, president of Fairchild Brothers and Foster, manufacturing chemists, who inherited the estate from his uncle; Mrs. B. Tappen Fairchild (Mr. and Mrs. Fairchild have maintained the sanctuary since the death of Benjamin Fairchild); also Thomas J. Watson, president, International Business Machines Corporation; Dr. Harry Woodburn Chase, chancellor of New York University; Dr. Robert Cushman Murphy, curator of oceanic birds, American Museum of Natural History, and honorary president of the National Audubon Society; Dr. Elmer Drew Merrill, professor of botany and supervisor of the Arnold Arboretum, Harvard University; Dr. Frederick H. Pough, assistant curator of mineralogy, American Museum of Natural History; Dr. C. Stuart Gager, director, Brooklyn Botanic Garden, is serving as president *pro tempore*, and Percy H. Jennings, president of the Vita-Glass Corporation, is treasurer.

#### THE AMERICAN CHEMICAL SOCIETY AND ORGANIZED LABOR

EFFORTS to enrol chemists in the ranks of organized labor are opposed by the American Chemical Society, according to an announcement made by Dr. Charles L. Parsons, secretary of the society.

The society has been informed of "a very serious situation" at Emeryville, Calif., where an attempt is being made to force professional men, including all research workers below the rank of department heads, to join a closed shop union within the Federation of Architects, Engineers, Chemists and Technicians, a C.I.O. affiliate. The plant affected is that of the Shell Development Company.

The directors of the society, Dr. Parsons points out, have definitely gone on record against the association of professional chemists and chemical engineers with a union, "thereby being rated as laborers and losing their status as professional men." He questions whether a pure research corporation can hope to survive under non-professional control.

Dr. Parsons wrote to members of the society in Emeryville in part as follows:

Nothing could be more fatal to the chemist, the engineer, the doctor or the lawyer than the loss of professional status. The society, of necessity, would be obliged to inform the chemical departments of every college and uni-

versity, as well as the chemists of America, as to the conditions to which their graduates would be subject should they accept employment with any corporation that would consent to any such fate for its professional men.

In the event that the Shell Development Company consents to a closed shop, with the Federation of Architects, Engineers, Chemists and Technicians as sole bargaining agent, and includes its professional men—which I can not conceive to be possible—every chemist who is a member of the union will very distinctly jeopardize his future.

Dr. Parsons reports that the American Chemical Society now has approximately 28,000 members, the largest number in its history. He states that the society will resist any attempt to coerce its members into any form of closed shop unionization. He concludes: "This is a professional organization, and the membership must make every effort to see that it so remains."

#### THE AMERICAN SOCIETY OF MAMMALOGISTS

THE twenty-third annual meeting of the American Society of Mammalogists was held in Chicago from June 9 to 13.

Officers of the society elected for the ensuing year are as follows: *President*, Walter P. Taylor, Texas A. and M. College, College Station; *Vice-presidents*, E. Raymond Hall, University of California at Berkeley, and A. Brazier Howell, the Johns Hopkins Medical School; *Recording Secretary*, Robert T. Orr, California Academy of Sciences; *Corresponding Secretary*, Emmet T. Hooper, Museum of Zoology, University of Michigan; *Treasurer*, Viola S. Schantz, U. S. Fish and Wildlife Service, Washington, D. C.; *Editor*, William B. Davis, Texas A. and M. College, College Station. *Directors*, elected for the period 1941-1943, are: Victor H. Cahalane, National Park Service, Washington, D. C.; William J. Hamilton, Cornell University; John Eric Hill, American Museum of Natural History; Remington Kellogg, U. S. National Museum, and Otis Wade, University of Nebraska. *Additional directors* are: William H. Burt, University of Michigan; Joseph S. Dixon, National Park Service, California; Colin C. Sanborn, Field Museum of Natural History, Chicago; W. E. Saunders, London, Ontario, and George Willett, Los Angeles Museum, California.

The following resolution unanimously adopted by the society is of general interest:

WHEREAS, There is now before the House of Representatives of the United States a bill known as the Murock Bill (H. R. 2675) and a companion bill before the Senate (S. 260) to open the Organ Pipe Cactus National Monument, Arizona, to prospecting and mining;

WHEREAS, The Organ Pipe Cactus National Monument was established to preserve for public use, education and

enjoyment the outstanding example of Sonoran desert in the United States;

**WHEREAS**, The area has been prospected for generations, without producing important mines and no mines are being operated therein to-day;

**WHEREAS**, The enactment of legislation opening this national monument to prospecting and mining under these circumstances would be a negative approach to the problems of an important and unique public reservation, which, by virtue of its situation on the international boundary between Mexico and the United States, has scientific and cultural possibilities of international importance;

*Therefore, be it Resolved*, That the American Society of Mammalogists, comprising a membership of about 1,000 scientists and educators, at its annual conference, June 12, 1941, petitions the Congress of the United States not to enact the Murdock and Hayden bills, which would result in impairment of this great public reservation, but petitions the Congress to appropriate sufficient funds to provide the protection and facilities required to put the Organ Pipe Cactus National Monument to its highest public use.

#### OFFICERS OF THE SOCIETY FOR RESEARCH ON METEORITES

THE council of the Society for Research on Meteorites, an affiliated organization of the American Association for the Advancement of Science, as elected for the 1941-45 term at the eighth meeting of the society held in Flagstaff, Ariz., on June 23, 24 and 25, is as follows:

*President*: Dr. Lincoln La Paz, Ohio State University.

*Vice-presidents*: Dr. F. R. Moulton, Smithsonian Institution Building, Washington, D. C.; Dr. Charles P. Olivier, Flower Observatory, University of Pennsylvania; Dr. L. J. Spencer, London.

*Secretary*: Dr. C. H. Clemenshaw, Griffith Observatory and the University of Southern California, Los Angeles.

*Treasurer*: Major L. F. Brady, Mesa Ranch School, Mesa, and the Museum of Northern Arizona, Flagstaff.

*Editor*: Dr. Frederick C. Leonard, University of California at Los Angeles.

*Councilors*: Professor Earle G. Linsley, Chabot Observatory and Mills College, Oakland, Calif.; Dr. Howard A. Meyerhoff, Smith College; Oscar E. Monnig, Texas Observers, Fort Worth, Texas; Dr. F. A. Paneth, University of Durham, England; Stuart H. Perry, *Adrian Telegram*, Michigan; Professor J. Hugh Pruett, University of Oregon; Dr. Fred L. Whipple, Harvard College Observatory.

The president during the 1937-41 term, Dr. H. H. Nininger, Colorado Museum of Natural History and the American Meteorite Laboratory, Denver, is *ex officio* a councilor during the 1941-45 term.

#### THE BIRTHDAY HONORS CONFERRED BY THE KING OF ENGLAND

*Nature* prints the names of scientific men and others

associated with scientific work that appear in the King's Birthday Honors List. These include:

*Baron*: F. A. Lindemann, personal assistant to the Prime Minister, professor of experimental philosophy, Oxford.

*G.B.E.*: Viscount Nuffield.

*K.C.B.*: Sir George Gater, permanent Under-Secretary of State for the Colonies and secretary, Ministry of Home Security, formerly clerk and education officer to the London County Council.

*K.C.M.G.*: Frank Gill, for services in development of the telephone industry and of international telephony; Dr. H. H. Scott, director of the Bureau of Hygiene and Tropical Diseases, London.

*Knights Bachelor*: Colonel A. S. Angwin, engineer-in-chief, General Post Office; R. W. Gillespie, a founder of the Fairbridge Farm Schools in Australia; Professor J. P. V. Madsen, professor of electrical engineering, University of Sydney, and chairman of the Radio Research Board, Australia; Dr. P. H. Manson-Bahr, for services to tropical medicine and as consulting physician to the Colonial Office; K. G. Mitchell, consulting engineer (roads), India; E. B. Pratt, managing director, Imperial Chemical Industries (India), Ltd.; Professor J. B. S. Stopford, vice-chancellor, University of Manchester.

*C.B.*: C. A. Taylor, regional director, London Telecommunications, General Post Office; F. A. Whitaker, civil engineer in chief, Admiralty.

*C.M.G.*: The Honorable F. E. Harris, Minister of Agriculture and Lands, Minister of Supply, Industry and Post-war Development, Southern Rhodesia; Dr. S. A. Neave, assistant director, Imperial Institute of Entomology; Dr. H. A. Tempany, agricultural adviser to the Secretary of State for the Colonies.

*C.I.E.*: W. Meiklejohn, senior conservator of forests, Bengal; C. F. C. Beeson, forest entomologist and conservator, Government of India.

*C.B.E.*: Professor F. C. Bartlett, professor of experimental psychology at the University of Cambridge and a member of the Flying Personnel Research Committee; Major G. P. Bulman, director of engine development and production, Ministry of Aircraft Production; W. Deacon, president of the Pharmaceutical Society of Great Britain; W. A. Elder, principal veterinary and agricultural officer, Swaziland; R. H. Franklin, assistant secretary, Ministry of Agriculture and Fisheries; Dr. J. A. Glover, lately senior medical officer, Board of Education; P. Good, deputy director, British Standards Institution; M. T. Tudsbery, civil engineer to the British Broadcasting Corporation; Dr. R. Wilson, Commonwealth statistician and economic adviser to the Treasury, Australia.

## RECENT DEATHS

DR. EDWARD KREMERS, until his retirement with the title of emeritus in 1935 professor of pharmaceutical chemistry at the School of Pharmacy of the University of Wisconsin, died on July 9. He was seventy-six years old. Dr. Kremers was director of the courses in pharmacy at the university from 1899 to 1935 and was pharmaceutical chemist at the Experiment Station from 1912 to 1935.

DR. EDGAR ALBERT BURNETT, chancellor emeritus of the University of Nebraska, died on June 28. He was seventy-five years old. Dr. Burnett was dean of the College of Agriculture and director of the Experiment Station until 1928 when he became chancellor of the university.

DR. CARL EDWARD MAGNUSSON, professor of electrical engineering and dean emeritus of the College of Engineering of the University of Washington, died on July 10 at the age of sixty-nine years.

HOWARD HACKEDORN, since 1918 professor and head of the department of animal husbandry at the

State College of Washington, died on June 30. He was fifty-six years old.

JOSEPHINE CURTIS FOSTER, professor in the Institute of Child Welfare at the University of Minnesota since 1926, died on July 3 at the age of fifty-two years.

DR. ROBERT ROBISON, head of the department of biochemistry of the Lister Institute and professor of biochemistry at the University of London, died on June 18 at the age of fifty-seven years.

DR. VICTOR JOLLOS, formerly of the Kaiser Wilhelm Institut für Biologie, Berlin-Dahlem, known for his work on heredity and genetics, died on July 5 at the age of fifty-three years. Dr. Jollos was visiting professor of zoology and genetics at the University of Wisconsin from 1934 to 1937. Before going to Madison he served on the faculties of the Universities of Berlin, Munich and Cairo.

THE death on March 17 is announced of Professor W. Vogt, professor of anatomy in the University of Munich, known for his work on embryology of the Amphibia.

## SCIENTIFIC NOTES AND NEWS

PROFESSOR ROSWELL P. ANGIER retired on June 30 as chairman of the department of psychology and associate dean of the Graduate School, Yale University. A portrait of Professor Angier was presented to the university on June 10 by a group of present and past colleagues and students. The portrait was painted by Professor Deane Keller, of the Yale School of Fine Arts, and has been hung in the reception hallway of the department of psychology.

M. L. WILSON, director of extension service in the U. S. Department of Agriculture, has been appointed director of nutrition by Paul V. McNutt, Federal Security Administrator. Mr. Wilson will aid Mr. McNutt in his work as coordinator of health, welfare and related defense activities and will be in charge of nutrition activities.

THE College of Physicians of Philadelphia has awarded the Alvarenga Prize to Dr. John J. Bittner, of the Roscoe B. Jackson Memorial Laboratory, Bar Harbor, Maine, "in recognition of his distinguished studies on cancer." This prize was established by the will of Pedro Francisco DaCosta Alvarenga, of Lisbon, Portugal, an associate fellow of the College of Physicians, to be awarded annually by the college on each anniversary of the death of the testator, July 14, 1883, "to the author of the best memorial upon any branch of medicine, which may be deemed worthy of the prize."

THE University of Königsberg has awarded to Professor Otto Hahn, director of the Kaiser Wilhelm Institute for Chemistry, Berlin-Dahlem, the Copernicus Prize for 1941 for his work on radioactivity.

DR. ALLAN PALMER, instructor in obstetrics and gynecology at the School of Medicine of the University of California, has been elected a foreign associate of the Physiological Society of Great Britain.

*Nature* reports that Dr. Max Nonne, professor of neurology at the University of Hamburg, on the occasion of his eightieth birthday was awarded the Goethe Medal for Art and Science.

TOWNES R. LEIGH, dean of the College of Arts and Sciences, University of Florida, received the honorary degree of doctor of science at the recent commencement exercises of the John B. Stetson University. The degree was awarded in recognition of his "long and distinguished service as professor of chemistry."

THE University of Arkansas conferred recently the honorary degree of doctor of science on Dean E. J. Kyle, of the School of Agriculture of the Agricultural and Mechanical College of Texas at College Station.

NOMINATIONS for officers of the American Society of Mechanical Engineers for 1942 include for *President*, James W. Parker, vice-president in charge of engineering, Detroit Edison Company; for *Vice-pres-*

idents, Clarke F. Freeman, vice-president in charge of fire prevention engineering and underwriting, Manufacturers Mutual Fire Insurance Company, Providence; Clair B. Peck, managing editor, *Railway Mechanical Engineering*; William H. Winterrowd, vice-president of the Baldwin Locomotive Works, and Willis R. Woolrich, dean of engineering and director of the Bureau of Engineering Research, University of Texas. Election will be held by letter ballot of the entire membership of 15,000, closing on September 23.

MISS MARY LOUISE MARSHALL, librarian of the Tulane University School of Medicine Library, New Orleans, was elected president of the Medical Library Association at its annual meeting in Ann Arbor, Mich., which was held on May 29, 30 and 31. Dr. John F. Fulton, of Yale University, was elected vice president, and Miss Anna C. Holt, of the Harvard University Schools of Medicine and Public Health Library, was reelected secretary. The convention in 1942 will be held at the Tulane University School of Medicine.

At the annual general meeting of the Institute of Physics, London, held on June 4, the following were elected to take office on October 1: *President*, Sir Lawrence Bragg; *Vice-president*, Professor W. Makower; *Honorary Treasurer*, Major C. E. S. Phillips; *Honorary Secretary*, Professor J. A. Crowther; *Ordinary Members of the Board*, Professor J. Chadwick and D. C. Gall.

*Nature* writes: "A unique ceremony took place in the Cabinet Room at 10 Downing Street on June 12, when the President of the Royal Society, Sir Henry Dale, admitted the Prime Minister into the fellowship of the Society. Among those present were the society's biological secretary, Professor A. V. Hill, M.P., the physical secretary, Professor A. C. G. Egerton, the foreign secretary, Sir Henry Tizard, and the assistant secretary, Mr. John D. Griffith Davies. After the Prime Minister had signed his name in the ancient Charter Book, Sir Henry Dale showed him the signature of his ancestor, Sir Winston Churchill, father of the great Duke of Marlborough, who was one of the early fellows of the Society, having been admitted into the fellowship in 1664."

THE *Journal* of the American Medical Association reports that Dr. Charles H. Best, professor and head of the department of physiology of the Faculty of Medicine of the University of Toronto, has been appointed director of the Banting-Best Department of Medical Research to succeed the late Sir Frederick Banting. Dr. Best will resign as associate director of the Connaught Laboratories, where he has been in charge of the purification and production of insulin.

JOHN A. KING, professor of mechanical engineering at the University of Kansas, has been appointed professor of mechanical engineering and head of the department in the College of Applied Science at Syracuse University. He succeeds the late Professor Albert R. Acheson.

DR. DONALD G. MARQUIS has been appointed chairman of the department of psychology of Yale University. Dr. Carl I. Hovland has been made director of graduate studies. Dr. Robert L. French has been appointed Sterling fellow in psychology, and Dr. Judson S. Brown, Harvard University, and Dr. Medford B. Wesley, University of Minnesota, have been appointed instructors.

PROFESSOR G. WATTS CUNNINGHAM, chairman of the department of philosophy of Cornell University, and Professor R. Clifton Gibbs, chairman of the department of physics, have been elected faculty representatives on the Board of Trustees of the university for terms of five and six years, respectively.

DR. R. A. Q. O'MEARA has been elected a fellow of Trinity College, Dublin, where he is at present acting professor of bacteriology.

PROFESSOR H. M. FOX, since 1927 professor of zoology in the University of Birmingham, has been appointed, from October 1, to the chair of zoology in the University of London, tenable at Bedford College.

PROFESSOR R. B. THOMSON has retired as head of the department of botany at the University of Toronto and has been appointed professor emeritus as from July 1. Dr. H. S. Jackson, who has been professor of mycology since 1928, has been appointed to succeed him as head of the department.

DAVIS E. RUSHING, of the Southern Experiment Station of the U. S. Bureau of Mines, has become assistant chemist in the Industrial Hygiene Division at Bethesda, Md., of the National Institute of Health.

DR. HAROLD E. JONES, director of the Institute of Child Welfare of the University of California at Berkeley, has been appointed a member of the National Research Council in the division of anthropology and psychology.

DR. RICHARD W. LINTON, formerly of the department of pathology, Cornell University Medical College, New York City, has joined the staff of the Biochemical Research Foundation, Newark, Del. He will work on problems of bacterial structure and chemotherapy.

DR. C. E. REHBERG, instructor in the department of chemistry at the University of Texas, has become research chemist with Sharples Chemicals, Inc., Wyandotte, Mich.

THE British Air Ministry has appointed Dr. T. F. Macrae and Squadron-Leader W. P. Stamm, of the medical branch of the Air Force, as biochemist and specialist medical officer, respectively, to watch over the food supplied to the R.A.F. Dr. Macrae, who will also hold the temporary rank of squadron-leader, is biochemist to the division of nutrition of the Lister Institute.

DR. VAN DEN BOS, chief assistant at the Union Observatory, Johannesburg, has been appointed to succeed Dr. H. E. Wood, who retired as director of the observatory last February.

THE following will be members of a British Committee, announced by Ernest Brown, Minister of Health in the House of Commons, which has been set up to investigate what further steps can usefully be taken to secure the utmost economy in the employment of medical personnel in the forces, the emergency hospital scheme, the Civil Defense Services and all other medical services: Geoffrey Shakespeare, Under-Secretary for the Dominions, *chairman*; Professor R. M. F. Picken, Welsh National School of Medicine; Sir Alfred Webb-Johnson, vice-president of the Royal College of Surgeons; Dr. J. Crichton Bramwell; Professor Sydney Smith, University of Edinburgh; Dr. J. A. Brown; Dr. William Malcolm Knox, and medical representatives of the Admiralty, War Office and Air Ministry. In addition, the following have agreed to be closely associated with the work of the committee: Sir Charles Wilson, president of the Royal College of Physicians; Sir Hugh Lett, president of the Royal College of Surgeons, and Dr. H. S. Souttar, chairman of the Central Medical War Committee.

CHAUNCEY J. HAMLIN, president of the Buffalo Society of Natural Sciences; Dr. Carlos E. Cummings, director of the museum, and H. Phelps Clawson, curator of anthropology, will sail from New York to Rio de Janeiro on August 1 to assist in reorganizing the exhibit and educational programs of Brazilian museums. A \$12,500 grant from the Rockefeller Foundation has been made to finance the journey in response to the request for aid in plans for reorganization of Senorita Heloisa Alberto Torres, director of the National Museum of Rio de Janeiro.

THE Civil Service Commission has announced an examination for industrial specialists at pay from \$2,600 to \$5,600 a year. Applications will not be accepted after August 7. Industrial specialists may be called upon to perform any of three types of service: liaison representative to develop and maintain working relationships with manufacturers of materials or equipment; consultants on industrial materials, methods and processes, evaluation of the

data of industrial concerns, and investigator and analyst in the field of industrial materials. To qualify for these positions, experience is required that has given the applicant a thorough knowledge of production methods and processes in one or more manufacturing industries. Applicants are rated on their education and experience. An oral examination may be given. There will be no written test and application forms may be obtained at any first- or second-class post office or from the Civil Service Commission in Washington. The Army Air Corps needs instructors for the Air Corps Technical Schools at Chanute Field, Rantoul, Ill.; Scott Field, Belleville, Ill.; Biloxi, Miss., and Wichita Falls, Texas. An insufficient number of qualified persons were obtained through previous examinations held for these positions. Applications should be filed at once. No written examination is required. There are three grades of positions—assistant instructor, at \$2,600; junior instructor, at \$2,000, and student instructor, at \$1,620. Opportunities for advancement are excellent. Within thirty days after appointment promotions to higher grade are possible with salaries up to a maximum of \$3,000 a year.

THE College of Engineering of the University of Wisconsin is making preparations for the meeting of the North Midwest Section of the Society for the Promotion of Engineering Education to be held at Madison on October 10 and 11. Three to four hundred guests from the colleges of engineering and the technical divisions of other schools in the states of Iowa, Michigan, Minnesota and Wisconsin are expected to attend.

At a meeting at the New York Zoological Park, on July 12, at which directors of the larger zoological parks in the United States discussed problems of animal supply created by the war, it was decided to form a National Association of Zoological Parks Directors. European sources for the purchase of animals are no longer accessible, but a collector will be available in Colombia, Ecuador and Venezuela, where it is hoped to obtain specimens. A quarantine station may be established at Mombasa, South Africa, to facilitate shipments from Africa. Directors attending the meeting, which was followed by a dinner at the Hotel Commodore, included Dr. William Mann, of the National Zoological Park, Washington; Edward Bean, of the Brookfield Zoological Park, Chicago; Roger Cenant, of the Philadelphia Zoological Garden; George P. Vierheller, of the St. Louis Zoological Park; John T. Millen, of the Detroit Zoological Garden; R. Marlin Perkins, of the Buffalo Zoological Garden, and Ward Walker, of the Garden at Hershey, Pa.

## DISCUSSION

THE BREATHING MECHANISM OF  
TURTLES

THE commonly accepted statement that turtles breathe air in a manner essentially similar to frogs is in serious error. Most of the text-books that mention the breathing mechanism of the turtle have perpetuated the respected opinion of Louis Agassiz<sup>1</sup> and many others that the air is pumped into the lungs by throat action. Casual observation of any turtle will show that the hyoid apparatus does indeed produce movements like those in the Amphibians. It is not surprising, therefore, that such actions should be deemed the essential mechanism of breathing.

During the course of operative experiments upon the box turtle in which the body cavity was opened it became obvious that throat action was ineffective and probably had nothing to do with the case. Further experiments to test the efficacy of the hyoid apparatus and to ascertain what did cause the movements of inhalation and exhalation indicated that the whole action was performed by distinct respiratory muscles in the body and not by the throat. That turtles with broken imperfect jaws continue to breathe and live with an impossible and leaking mouth pump, that there are no valves in the nostrils of turtles, and that experimentally the mouth may be tied open indefinitely without affecting the animal's breathing should explode the notion of a mouth pump. Further, tracheotomy shows no air movements in the trachea during the expansion and contraction of the throat. The throat actions do result in aeration of the mouth, and in aquatic turtles where water is taken in and out of the mouth, it affords respiration through the lining of the mouth and pharynx. This has been shown by S. H. and S. P. Gage<sup>2</sup> in 1885.

In his excellent book "Turtles of the United States and Canada," Mr. Pope<sup>3</sup> puts no faith in throat action, but points out that it appears to be a rotation of the girdles which is responsible for the chief respiratory movements. This is an interesting view but somewhat obscure. It is doubtful whether the pelvic girdle should be considered in this regard, but it is true that the pectoral girdle does rotate during the respiratory movements.

The essence of the whole mechanism has been adequately described in a paper by S. Weir Mitchell and George R. Morehouse<sup>4</sup> published in 1863, and appar-

ently forgotten by the subsequent generations of comparative anatomists. Briefly, inspiration is accomplished by two flank muscles which, acting like the mammalian diaphragm, enlarge the coelom and thus suck air into the lungs. The shoulder girdle passively rotates forward during inhalation. To accomplish expiration, the turtle uses an expiratory muscle consisting of two anterior and two posterior bellies connected by a tendinous band continuous across the mid-ventral line, and common to both sides of the animal. Air is forced out by the concerted action of the four parts of this muscle which compress the viscera against the lungs. This action may be aided by pulling in the legs and neck which thus further tend to decrease the body cavity. It has been clearly shown that girdle, leg or neck movements need not take place. The muscles mentioned are entirely adequate to the task. It follows then that an open body cavity will stop breathing. It is easy to demonstrate with the use of a manometer attached to the coelom that the pressure momentarily dips during inspiration and rises during expiration.

Dr. Simon H. Gage,<sup>5</sup> writing in 1883, says: "During the last twenty-five years the mechanism of respiration in the Chelonia has been investigated with considerable thoroughness both in this country and Europe; and at present the Chelonian form of respiration is considered to be comparable with that of the mammal rather than that of the frog, as formerly supposed." In spite of misleading text-books, the suspicion is strong that the turtles have not changed since.

IRA B. HANSEN

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NICOTIANA RUSTICA CULTIVATED BY  
PUEBLO INDIANS

IN 1934, while engaged in an ethnologic study of the Indian Pueblo of Tamaya (commonly called by its Spanish name, Santa Ana, located on the Jemez river about 25 miles north of Albuquerque), I was told by an Indian informant that tobacco was cultivated by a certain individual at the pueblo's farms at Ranchitos (on the east bank of the Rio Grande, just north of Bernalillo, N. M.). Subsequently, I learned that this individual was a member of a society of medicine men and that the tobacco was grown for ceremonial use. I obtained a specimen of this tobacco. It has been identified as *Nicotiana rustica* by Mr. Volney H. Jones, ethnobotanist in the Museum of Anthropology, University of Michigan, to whom I am indebted for much assistance in the preparation of this paper. The specimen has been deposited in the Museum of Anthropology, University of Michigan (Cat. No. 14698). In

<sup>5</sup> S. H. Gage, *Proceedings American Association Advancement of Science*, Vol. 32, pp. 316-318, 1883.

<sup>1</sup> Louis Agassiz, "Contributions to the Natural History of the United States," Vol. 1, p. 281, 1857.

<sup>2</sup> S. H. Gage and S. P. Gage, *Proceedings American Association Advancement Science*, Vol. 34, pp. 316-318, 1885.

<sup>3</sup> C. H. Pope, "The Turtles of the United States and Canada," 1939.

<sup>4</sup> S. Weir Mitchell and George R. Morehouse, *Smithsonian Contributions to Knowledge*, Vol. 13, No. 159, 1863.

1936, Mr. Jones himself saw tobacco under cultivation at the Indians' farms at Ranchitos and was told by an Indian that this was the kind of tobacco commonly grown and used by them. Mr. Jones judged this tobacco to be *N. rustica*, although he did not have the opportunity to make definitive identification at that time.

This discovery is of interest for two reasons: (1) There is very little evidence indeed to indicate that tobacco of any kind has ever been cultivated by the Pueblo Indians of the Southwest; and (2) it is surprising to find this particular species of *Nicotiana* in this region.

Ad. F. Bandelier, who made first-hand studies of the Pueblo Indians in the 1880's and who was intimately acquainted with the documentary history of the pueblos, has declared that "tobacco was not known to the Pueblos until Spanish rule became established."<sup>1</sup> John H. Bowman, an Indian agent of the "Navajo Agency, New Mexico," in a report to the Commissioner of Indian Affairs dated September 9, 1884, states that the Hopi cultivated tobacco "to an insignificant extent" (p. 137). George Vasey states that *N. rustica* "was cultivated by the Indians in New Mexico and Arizona, as observed by Dr. Ed. Palmer."<sup>2</sup> Considerable search has failed to discover this statement in the publications of Dr. Palmer. But, in one of Palmer's papers, we find evidence to the contrary: he states that *N. attenuata*, *N. trigonophylla* and *N. bigelovia* were used by the Indians of the Southwest, but implies that they were not cultivated.<sup>3</sup> Robbins *et al.* state that the Tewa Indians of north central New Mexico "formerly cultivated" *N. attenuata*, but cite no evidence whatsoever in support of this claim.<sup>4</sup> A. F. Whiting lists *N. attenuata* and *N. trigonophylla* as the tobaccos used by the Hopi Indians and remarks that "it is said that tobacco is cultivated sporadically."<sup>5</sup> Mr. V. H. Jones observed a few plants of *N. attenuata* growing here and there, at random, among other plants in gardens near the Hopi pueblo of Walpi. He was told by a trustworthy Hopi that these tobacco plants had not been planted, that they had come up of their own accord, but the gardeners had allowed them to remain and that they would be harvested eventually. This might be called "semi-cultivation." Thus, the specimens collected by myself at Ranchitos and the observations of Mr. Jones at the same place, constitute the

only conclusive evidence of intentional and systematic cultivation of tobacco among the Pueblo Indians of which the present writer is aware.<sup>6</sup>

Our discovery of *N. rustica* at Ranchitos is the only conclusive evidence of the existence of this species in the Southwest that we have. We know of only one other claim that this species has been found in this region, *viz.*, the statement previously quoted from Vasey. But, as we have seen, this statement is opposed, rather than supported, by the authority whom Vasey cites. Wm. A. Setchell, in "Aboriginal Tobaccos," states that *N. rustica* was cultivated in the Eastern Woodland and the Southeastern culture areas. The western boundary of *N. rustica*, according to Setchell, "is probably along the line of the eastern boundary of the 'Plains area' as outlined by Wissler [in 'The American Indian']," *i.e.*, but a short distance west of the Mississippi River (p. 402). The Southwestern area, says Setchell, "used an entirely different species, *viz.*, *Nicotiana attenuata* Torrey," (p. 410). He also places *N. trigonophylla* in the Southwest, "ranging from southeastern California to the western borders of Texas" (pp. 412-13).

*N. rustica* is believed to have originated in Mexico and to have entered the Southeast "through the southwestern corner of Texas," (Setchell, p. 410). The presence of this species under cultivation at Tamaya to-day remains to be explained. It may have been introduced within the past 50 years or so from some eastern Indian reservation, to be sure. But the possibility that it may be a relic of the original diffusion from Mexico can not be entirely dismissed at this time.

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# CERVICAL EXPOSURE AND ABRASION IN HUMAN TEETH FOR DIFFERENT AGE CLASSES<sup>1</sup>

THERE are numerous references in dental literature to the existence and cause of abraded areas along the gingival margin of human teeth, but the degree of incidence of this condition has not been determined. From clinical data recently collected, it appears that this incidence is unexpectedly high. For these reasons a preliminary report is presented at this time.

Two hundred individuals, divided equally as to sex, and into four age groups, 20-29, 30-39, 40-49 and 50-59, were examined. The examination consisted of measuring the linear extent of exposed cementum or dentin, on the buccal, or labial, surface of each tooth

<sup>1</sup> *Final Report*, etc., Pt. I, p. 37 (Papers of the Archeological Institute of America; Amer. Series III; 1890).

<sup>2</sup> Report of the botanist, p. 76 (in Report of the Commissioner of Agriculture for 1886).

<sup>3</sup> "Plants used by the Indians of the United States," p. 650, *American Naturalist*, Vol. 12, 1878.

<sup>4</sup> W. W. Robbins, J. P. Harrington and B. Freire-Marreco, "Ethnobotany of the Tewa Indians," p. 108, Bull. 55, Bureau of American Ethnology, 1916.

<sup>5</sup> "Ethnobotany of the Hopi," p. 90, Bull. 15, Museum of Northern Arizona, 1939.

<sup>6</sup> Professor E. F. Castetter, of the University of New Mexico, who has been making studies of plants used by the Pueblo Indians, may have data on this point.

<sup>1</sup> *American Anthropologist*, 23: 397-414, 1921.

<sup>2</sup> A project of the Research Foundation, the Ohio State University, carried on with the aid of a grant from the Procter and Gamble Company.

in the mouth. The degree of abrasion, if any existed, was measured by determining the depth of any cuts or grooves found. A study was also made of the relationship between the condition of oral hygiene and the presence, or absence, of abrasion.

The results show that only a small percentage of teeth with 0.5 mm of exposure were abraded, whereas a very high percentage of those with 1.0 mm, or more, exposure showed some loss of the dentin. Therefore, it appears that 1.0 mm of exposure is critical in the sense that it permits considerable wear if the subject practices average oral hygiene. In the age groups 20-29, 30-39, 40-49, 50-59, critical exposures existed on one or more teeth in 58 per cent., 84 per cent., 96 per cent. and 94 per cent. of the subjects, respectively.

The incidence of some extent of abraded cementum and dentin increased with age from 42 per cent. to 76 per cent. The percentage of subjects showing wear greater than 0.5 mm deep increased from 4 per cent. in the age group 20-29 to 42 per cent. in the groups above 40 years of age.

An excellent correlation was found between the thoroughness of oral hygiene and the occurrence of abrasion. In those portions of the mouth where tooth-brushing was most thorough, and among those people with the best oral hygiene, the incidence of abrasion was the highest and on the other hand, where poor oral hygiene was observed very little abrasion was noted.

The influence of age and oral hygiene on exposure and abrasion of cementum and dentin has been briefly summarized here. It is planned to present this data in detail at a later date along with a discussion of the effect of sex and the position of the tooth in the mouth on exposure and abrasion.

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### THE EFFECT OF CHLOROFORM ON SOME INSECT BITES

DUE, in part at least, to economic factors the control of mosquitoes and biting insects is not always feasible or practical. Nevertheless, this state of affairs affords little consolation to the susceptible individual who must live and work where these pests abound.

In 1924 the writer noticed that cotton saturated with carbon tetrachloride rubbed briskly on mosquito bites caused a rapid cessation of pruritis. Later chloroform was substituted, and found superior. Since then similar trials have been made on a number of individuals, including several physicians. It was felt that the testimony of the latter would add some degree of validity to these rough tests.

The arthropods concerned in these tests were the local red bug, *Trombicula sp.*, the mosquitoes *Culex fatigans* and *Aedes aegypti*, the prevalent black fly, *Simulium quadrivittatum*, and the gnat, *Culicoides*

*furans*, a most annoying species common along the coastal plain of the island.

In all instances the results confirmed initial observations. Usually a more beneficial effect was experienced if treatment were not too long delayed. Nevertheless, a physician whose entire body surface was covered with mosquito bites after a trip to an adjacent island, condescended to try chloroform on a limited area approximately 48 hours after incurring the bites. The relief was so marked that he soon applied the drug on a considerably larger scale.

The dermatologist may present objections to the use of chloroform as a counter-irritant. Of course this substance must be kept from the eyes and mucous membranes. In all tests made no effect other than a transient burning sensation was noted. In one instance a woman long affected with angioneurotic edema, and very susceptible to mosquito toxin, used chloroform to obtain relief over a period of several months. The objective was attained without causing any noticeable change in the edematous condition.

The tests indicated here are obviously not critical ones. It is believed, however, that sufficient evidence has been accumulated to justify calling attention to the palliative potentialities of chloroform against the toxins injected by mosquitoes and other noxious arthropods. It deserves a trial for flea bites and schistosome dermatitis, provided of course, the areas involved in the case of the latter are not too extensive.

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### PRESERVATION OF SAMPLE AREAS IN THE NATIONAL FORESTS

I WOULD like to make a brief reply to Dr. Henry I. Baldwin's communication in *SCIENCE* for June 27, 1941, in which he condemns my criticism in a communication in *SCIENCE* for May 2, 1941, of the failure of the U. S. Forest Service to preserve in the National Forests sample areas exhibiting the finest development of the different types of our primeval forests.

Dr. Baldwin asserts that reservations of "really valuable timber" (whatever that may mean) "have been made by the Forest Service in a large number of cases."

Now what the Forest Service has done and is doing is not a matter of argument but of fact and of record. Either such reservations in the National Forests exist or they do not. If they do, do they contain optimum or near-optimum stands of the wonderful forests of the western United States;—forests unequaled anywhere else in the world, whose unique scenic magnificence as well as scientific interest demanded that adequate areas of the finest stands should be preserved?

Do any permanent reservations of that bureau contain stands of Douglas fir in which the mature trees average 275 feet or more in height; Sitka spruces, western hemlocks, lowland white firs, western white pines or western red cedars 225 feet tall; Port Orford cedars, Ponderosa pines, western larches or Noble firs 180 feet tall or more, to name a few of the species? Hundreds of square miles of stands of timber of such sizes have been sold out of the National Forests.

While the Forest Service has made vast "reservations" of unimportant and commercially valueless areas, a great deal of traveling in the forest regions of the west during past years and recently a number of letters of inquiry have failed to bring out from the

Forest Service any evidence that it is doing much of anything in the preservation of any fine samples of the forests of our western states, though, of all the government bureaus, it alone had the opportunity to accomplish it and was under the deepest obligations to the nation to do so.

The big timber in the National Forests is mostly gone. Only in certain of the National Parks will the Americans of the future be able to see a few small remnants of the wonderful forests of the western United States in their best development.

WILLARD G. VAN NAME

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## SCIENTIFIC BOOKS

### ADVANCES IN ENZYMOLOGY

*Advances in Enzymology and Related Subjects.* Edited by F. F. NORD and C. H. WERKMAN. Vol. I. 433 pp. + 56 illustrations. New York: Interscience Publishers, Inc. \$5.50. 1941.

THE present volume consists of a collection of ten independent articles contributed by investigators from various countries (7 from the United States and one each from Germany, U. S. S. R. and Holland). As stated in the preface, this series of monographs is initiated at a time when research and original thinking are subjected to the gravest of interruptions; it may be difficult to maintain international collaboration in future volumes. According to a letter received by Dr. F. F. Nord, who served as editor of both publications, the aims and scope of the "Advances in Enzymology" are similar to those of the now defunct "Ergebnisse der Enzymforschung."

The ever widening field of enzyme research and the scattering of publications over a large number of scientific periodicals makes it desirable to present from time to time summarizing articles of timely topics by authors eminent in the field. The authors are encouraged to present their own view-point and experimental results and to treat their subject in a critical and synthetic manner rather than in the form of a mere compilation of the literature. In the opinion of the reviewer, the editors, both of whom are well-known investigators in the field of enzyme research, have succeeded in combining in the present volume a number of extremely interesting and valuable articles. While it is impossible to consider in detail each article, a few remarks concerning some of them will be made.

Protein structure is reviewed by Bull. The peptide linkage is considered to be the only important co-valent bond between amino acid residues in proteins. In this connection the theory of peptide chain folding of Wrinch which postulates another type of co-valent

bond is examined in some detail. The x-ray diffraction pictures of fiber proteins and their bearing on the structure of these fibers, particularly that of  $\alpha$ - and  $\beta$ -keratin, are discussed. Bull regards Svedberg's idea of molecular weight classes of proteins (whole number multiples of the unit molecular weight of 17 600) as unfounded. The Bergmann theory of protein structure is based on the concept of molecular weight classes and of a regular and invariant periodicity of occurrence of amino acids in a single peptide chain; the molecular weight is obtained by multiplying the total number of amino acid residues by the average residue weight. Bull points out that the calculation of the average residue weight is uncertain, because the analytical results for individual amino acids in most proteins are not sufficiently accurate at the present time. Other problems discussed are those of the shape of globular proteins, hydration and denaturation.

The article of Bergmann and Fruton is a valuable review of their work on the specificity of proteinases. A good deal of exact information is now available, due mainly to the use of synthetic substrates of known structure and of crystalline enzymes. Pepsin, trypsin and chymotrypsin are regarded as the best defined proteinases. The typical substrates for pepsin and chymotrypsin contain tyrosine or phenylalanine residues; the former enzyme acts at the peptide linkage that involves the amino group of these amino acids, while the latter enzyme acts at the peptide linkages involving the carboxyl group of these amino acids. Trypsin acts at the carboxyl end of lysine or arginine residues. Enzymatic synthesis of single peptide linkages has been effected with a number of proteinases.

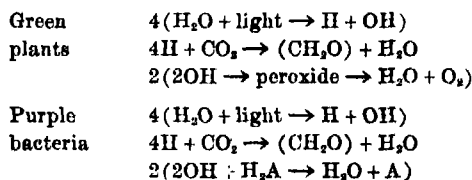
In Lipmann's article on phosphate bond energy, the central theme is that there are two groups of organic phosphate compounds found in nature, a large group with relatively low potential energy in the phosphate bond and a smaller group which con-

tains an energy-rich phosphate bond. To the first group belong all compounds in which phosphate is combined with an alcoholic hydroxyl in an ester linkage, *e.g.*, hexose-, pentose-, triose-, glycerol- and glyceric acid phosphates. The change in standard free energy resulting from the splitting of the ester linkage of this group of compounds is estimated at -2,000 to -4,000 calories. The same numerical values with reversed sign gives a measure of the group potential. The energy-rich phosphate bonds are of the type, P-O-P, N-P, carboxyl-P, enol-P, represented by such compounds as adenosinetriphosphate, creatine and arginine phosphate, phosphoglyceryl- and acetyl phosphate and phosphoenol-pyruvate. The average energy available in these types of linkages is assumed to be 9,000 to 11,000 calories. The following reaction phases are distinguished in the constantly occurring metabolic turnover of phosphate. (1) Introduction of inorganic phosphate into ester linkage. (2) Generation of energy-rich phosphate bonds. (3) Distribution of phosphate by the adenylic acid system. (4) Regeneration of inorganic phosphate. A fine coordination between a great number of enzymatic reactions is necessary in order to avoid obstruction of the phosphate cycle by the accumulation of intermediates. The fall of the phosphate group potential from a higher to a lower level during the metabolic phosphate cycle provides a source of energy which may be utilized for a variety of purposes, *e.g.*, resynthesis of glycogen, mechanical work during muscular contraction, bone formation and various organic chemical syntheses in the cell. Lipmann suggests that a large part of available metabolic energy passes through energy-rich phosphate bonds; this provides a uniform source of energy which can be used for all-around purposes. Transfer of other active groups (amino, amidine, methyl, acetyl) occur quite generally in cellular metabolism. As in the case of phosphate transfer some of these reactions are reversible, while others are not. In the latter case there occurs a decrease in the group potential.

Sumner's article deals with the chemical nature of catalase. Theories concerning the mechanism of catalase action are discussed, especially the theory of Keilin and Hartree which is based on the claim that catalase has a diminished action on hydrogen peroxide in the absence of molecular oxygen. This observation has

not been confirmed by Sumner. He proposes a mechanism in which catalase containing ferric iron forms a peroxide which is decomposed by another molecule of hydrogen peroxide.

There are two articles on photosynthesis, one by Franck and Gaffron and another by Van Niel; the latter deals more specifically with bacterial photosynthesis. Both articles contain a good deal of unpublished material. The quantum efficiency, *i.e.*, the number of light quanta needed for the photochemical reduction of one molecule of carbon dioxide, is discussed at some length. The value of Warburg and Negelein of four quanta per molecule of carbon dioxide has now been superseded by one which is three times as large. The present trend is to interpret photosynthesis in plants and certain bacteria as an oxido-reduction process which may be expressed by the following equations:



Photosynthesis in purple bacteria occurs without liberation of molecular oxygen. The peroxide mechanism in green plants is here replaced by one in which appropriate hydrogen donors (*e.g.*, hydrogen sulfide) regenerate the system. Van Niel suggests that the photochemical decomposition of water with the aid of chlorophyll and special enzymes is the light reaction, while the actual reduction of carbon dioxide is a dark reaction. This does not imply, however, that carbon dioxide itself is the immediate hydrogen acceptor or that it is necessarily converted to carbohydrates.

In other articles Holzapfel deals with the physical chemistry of virus proteins, Green with enzymes and trace substances, Kurssanov with enzymatic processes in living plants and Vonk with digestion in lower vertebrates. The article by Kurssanov summarizes literature not easily accessible in this country, but contains too few technical details to judge the merit of many of the experiments which are reported.

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## SOCIETIES AND MEETINGS

### THE EASTERN SECTION OF THE SEISMOLOGICAL SOCIETY OF AMERICA

THE Eastern Section of the Seismological Society of America held its sixteenth annual meeting jointly with the Section of Seismology, American Geophysical

Union, on May 2, 1941, at Georgetown University, Washington, D. C. The members were welcomed in the name of the president of the university by the Reverend F. W. Sohon, S.J., director of the Georgetown seismic station. Ralph R. Bodle, of the U. S.

Coast and Geodetic Survey, vice-chairman of the section, presided at the meeting because of the absence of the chairman, the Reverend A. J. Westland, S.J., who was still suffering from the effects of an automobile accident.

Fifteen papers and reports were presented. E. L. Perry extended his previous report on "Methods and Operations" to include important information on recording paper; J. Lynch, S.J., aroused much interest by his paper on "Amateur Seismology"; and the New England group, headed by D. Linehan, S.J., gave their results of an intensive study of the New Hampshire earthquakes of December, 1940. B. Gutenberg kindly repeated the seismological part of his paper on "Tectonic Processes" given on May 1 before the Section of Tectonophysics of the American Geophysical Union.

The following officers were elected unanimously for next year: *Chairman*, R. R. Bodle, of the U. S. Coast and Geodetic Survey; *Vice-Chairman*, E. L. Perry, Williams College; *Secretary*, W. A. Lynch, Fordham University; *Treasurer*, H. Landsberg, Pennsylvania State College; *Fifth Member of the Executive Committee*, A. J. Westland, S.J., Spring Hill College.

Georgetown University acted as host to the section at an excellent luncheon that brought the proceedings to a close.

WILLIAM A. LYNCH,  
*Secretary*

FORDHAM UNIVERSITY

### THE SOUTHEASTERN SECTION OF THE BOTANICAL SOCIETY OF AMERICA

THE second annual meeting of the Southeastern Section of the Botanical Society of America was held in Charleston, S. C., from June 13 to 15, with 41 botanists and their guests participating. Registration was at the College of Charleston. Other institutions cooperating included the Charleston Library Society, which arranged a display of rare botanical works, and the Charleston Museum, custodian of the Stephen Elliott Herbarium.

The program featured tours about the vicinity of Charleston. The botanists were shown work in progress at the U. S. Regional Vegetable Breeding Laboratory by Director B. L. Wade. They were received at Middleton Gardens and also at Middleburg Plantation, the seventeenth century home of E. S. Dingle, bird and flower painter. Other trips included the site of Michaux's garden, the Francis Marion National Forest and Bull's Island of the Cape Romain National Wildlife Refuge. Collecting was done in a variety of southern coastal plain environments, including a cypress swamp, a savannah and a barrier island.

The Charleston Museum was host for an evening's entertainment, where by motion pictures and koda-

slides the botanists were shown scenes from Cypress Gardens, historical Charleston and some of the local flora and bird life.

The business meeting was held after the dinner on Saturday evening. Dr. H. L. Blomquist, retiring secretary, presided, in place of Dr. W. C. Coker, retiring chairman, who had been unfortunately called home. Dr. J. H. Miller, the new chairman, talked on "The Need for Expanding the Botanical Sciences in the Southeastern States." Director E. Milby Burton, of the Charleston Museum, reported on a project to create a park of the Michaux garden site. A resolution was unanimously voted to the effect that the Southeastern Section of the Botanical Society of America endorsed the project and recommended that the administration of the restored Gardens be vested in the Charleston Museum.

In a discussion of the aims of the section it was emphasized that its object was to increase botanical activity and to strengthen the influence of the Botanical Society of America in the South. In furtherance of this object, it was decided to distribute a list of specialists who could assist the members in their taxonomic problems, and to arrange for a breakfast for the section at the Dallas meetings of the Botanical Society.

KENNETH W. HUNT,  
*Secretary*

### THE ELEVENTH ANNUAL FIELD CONFERENCE OF PENNSYLVANIA GEOLOGISTS

THE eleventh annual Field Conference of Pennsylvania Geologists was held at Johnstown, Pa., on May 30, 31 and June 1. The Pennsylvania Topographic and Geologic Survey acted as host. The committee consisted of State Geologist Dr. George H. Ashley, *chairman*, Assistant State Geologist Dr. R. W. Stone and R. M. Foose and M. N. Shaffner. About fifty geologists attended. Most of these were from Pennsylvania, but Maryland, New Jersey, New York, Virginia and West Virginia were represented.

Registration was on Friday morning, May 30, at the Fort Stanwix Hotel. During the afternoon a trip led by Dr. Ashley, R. M. Foose and M. N. Shaffner visited exposures of the Allegheny formation about Johnstown. The annual dinner was held that evening at the Fort Stanwix Hotel. Dr. Stone acted as toastmaster. Mayor John A. Conway welcomed the members of the conference. The principal speaker was Andrew B. Crichton, local mining engineer, who spoke about the economic aspects of coal in the Johnstown basin, and presented interesting statistics he has compiled on coal reserves in the Appalachian field. Other speakers were: Dr. B. L. Miller, of Lehigh University; Dr. Arthur Bevan, state geologist of Virginia; Drs. F.

M. Swartz and C. A. Bonine, of the Pennsylvania State College; Dr. C. R. Fettke, of the Carnegie Institute of Technology; R. F. Myers, of Muhlenberg College, and Dr. Parke A. Dickey, of the Pennsylvania Survey. E. A. Munyan, of Charleston, W. Va., showed lantern slides of the ninth conference, which was held in West Virginia in 1939.

On Saturday the group was led by R. M. Foose and M. N. Shaffner through the gorge of the Conemaugh River which cuts across the axis of the Laurel Hill anticline exposing all the rocks of the Allegheny, Pottsville and Mississippian series, and the Upper Devonian strata. Of particular interest was the almost continu-

ous section of rocks from the base of the Pottsville series to the Catskill red beds of the Devonian at the northwest end of the gorge. The group was entertained at supper that evening at the home of Mr. and Mrs. Crichton at Westmont.

The trip on Sunday morning was led by Dr. F. M. Swartz. The party drove eastward over the Allegheny Plateau, crossing rocks of the Coal Measures, and descended the Front east of Portage seeing sections of the Mississippian, Devonian, Silurian and Upper Ordovician Systems. The party disbanded near Altoona.

M. N. SHAFFNER,  
Secretary

## SPECIAL ARTICLES

### PREVENTION OF TUMOR GROWTH (CARCINOMA 2163) BY INTRAVENOUS INJECTIONS OF YEAST AND VITAMINS

In 1937 Kinoshita,<sup>1</sup> using dimethylaminoazobenzene (butter yellow), produced liver cancer in rats. Ando<sup>2</sup> reported that the addition of yeast to a butter yellow-rice diet reduced the incidence of liver cancer.

In 1939 Nakahara and his co-workers<sup>3</sup> reported that Vitamins (B<sub>1</sub>, B<sub>6</sub>, nicotinic acid) and their combina-

prevent liver cancers in rats which had been fed butter yellow when a diet of unpolished rice was mixed with 15 per cent. of brewer's yeast.

Recently Rhoads and his co-workers<sup>5</sup> have demonstrated that riboflavin mixed with casein substantially protects the rats against liver cancers. When either riboflavin or casein alone was added to the diet, the incidence of liver cancer was reduced from 100 per cent. to 70-80 per cent. When both substances were

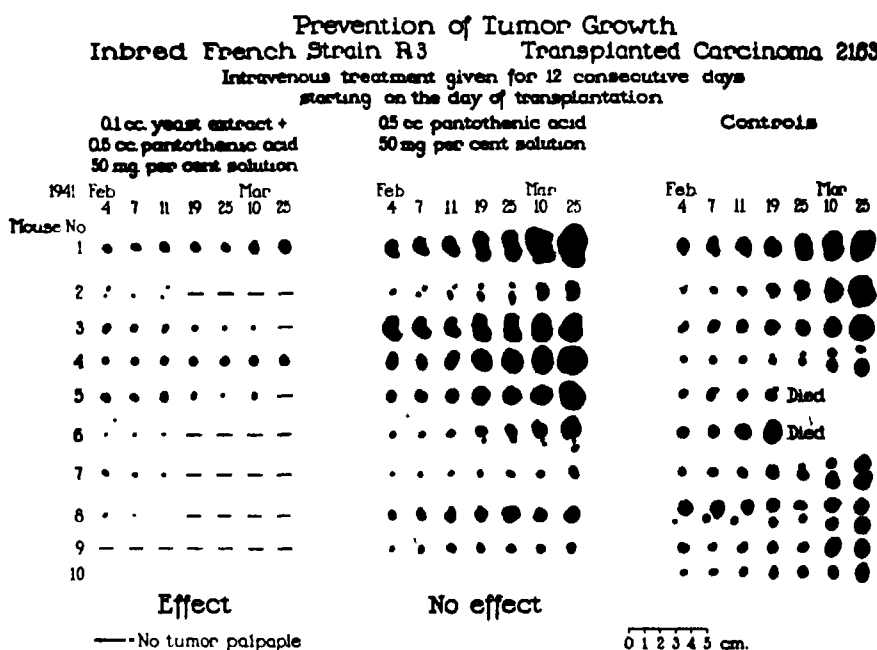


FIG. 1

tions as well as liver eluate and liver-filtrate had no effect on the development of liver cancer.

In 1941 Sugiura and Rhoads<sup>4</sup> showed that they could

<sup>1</sup> R. Kinoshita, *Trans. Soc. Path. Jap.*, 27: 665, 1937.

<sup>2</sup> T. Ando, *Gann*, 32: 252, 1938.

<sup>3</sup> W. Nakahara, T. Fujiwara and K. Mori, *Gann*, 33: 406-427, 1938.

added simultaneously to the diet, the incidence of malignancy was reduced to 3 per cent.

<sup>4</sup> K. Sugiura and C. P. Rhoads, *Cancer Research*, 1: 3-16, 1941.

<sup>5</sup> C. I. Kensler, K. Sugiura, N. F. Young, C. R. Halter and C. P. Rhoads, *SCIENCE*, 93: 808-810, 1941.

In 1938 Maisin and Pourboix<sup>6</sup> had shown that by feeding of yeast they could reduce the percentage of tumors produced by carcinogenic substances.

Since then two papers<sup>7, 8</sup> have been published from this laboratory demonstrating the complete disappearance of spontaneous mammary carcinomas in 30 per cent. of the treated mice following intravenous injections of a watery yeast extract.

In a set of experiments which are the basis of this brief report we tried to influence the takes of a transplanted Carcinoma 2163 in the R III strain. This tumor is a mammary adenocarcinoma which in this

TABLE I  
PREVENTION OF TUMOR GROWTH. INBRED FRENCH STRAIN  
R III TRANSPLANTED CARCINOMA 2163\*

	No of animals	Non-takes	Takes
Yeast and pantothenic acid	40	19 (47.5 per cent.)	21
Yeast	30	6 (20 per cent.)	24
Pantothenic acid	40	1 (2.5 per cent.)	39
Controls	40	2 (5 per cent.)	38

\* In the first two experiments (20 animals) the intravenous treatment was started on the day of the transplantation and continued for 10 consecutive days. Since then in these prevention-experiments the intravenous treatment was given on 10 consecutive days and stopped on the day of transplantation.

laboratory was found to be transplantable in 95 to 100 per cent. of animals of this strain, the strain in which it arose. In our experience this carcinoma has proved very resistant to treatment.

The yeast extract for the prevention experiments was prepared as described originally<sup>7</sup> and was given intravenously in doses of 0.1 ccm (containing 4 mg of dry matter). 0.5 ccm pantothenic acid (calcium pantothenate dextrorotary) of a 50 mgm per cent. solution was administered intravenously. 0.5 ccm thiamin of a 50 mgm per cent. solution was used for intravenous application. We obtained these substances through the courtesy of Messrs. Merck and Company.

TABLE 2  
PREVENTION OF TUMOR GROWTH. INBRED FRENCH STRAIN R  
III. TRANSPLANTED CARCINOMA 2163\*

	No of animals	Non-takes	Takes
Yeast + Riboflavin	29	18 (62 per cent.)	11
Yeast	28	6 (4 per cent.)	22
Riboflavin	29	4 (14 per cent.)	25
Yeast + Thiamin	28	5 (20 per cent.)	23
Thiamin	29	1 (4 per cent.)	28
Controls	29	.....	29

\* Intravenous treatment given for 10 consecutive days before transplantation. Injections were stopped on the day of transplantation.

<sup>6</sup> J. Maisin and Y. Pourboix, *Comptes rend, Soc. biol.*, 127: 1477, 1938.

<sup>7</sup> R. Lewisohn, C. Leuchtenberger, R. Leuchtenberger and D. Laszlo, *Proc. Soc. Exp. Biol. and Med.*, 43: 558-561, 1940.

<sup>8</sup> R. Lewisohn, C. Leuchtenberger, R. Leuchtenberger and D. Laszlo, *Am. Jour. Path.*, 17: 251-260, 1941.

The accompanying charts demonstrate the effects of yeast, different vitamins and combinations of these substances on the prevention of tumor-growth. It is evident that the vitamins (pantothenic acid, riboflavin and thiamin) alone have none or very little effect on tumor growth. Yeast alone prevents tumor growth in about 20 per cent. only. This tumor-preventing effect of yeast was markedly improved by adding pantothenic acid (non-takes 47 per cent.) or riboflavin (non-takes 62 per cent.) to the yeast extract. Addition of thiamin to the yeast extract did not improve the tumor-preventing action.

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#### EFFECTS OF VITAMIN B<sub>1</sub> ON WOODY EROSION-CONTROL PLANTS<sup>1</sup>

RECENTLY there has been considerable interest in the use of vitamin B<sub>1</sub> for stimulating plant growth. The results reported here are concerned with the relation of added vitamin B<sub>1</sub> (thiamin chloride) to the survival and growth rate of young woody erosion-control plants in the field. By a woody erosion-control plant is meant one that possesses to a high degree the ability to withstand indifferent handling, drought, adverse soil conditions and vigorous competition. For deciduous erosion-control plants, these requirements are best realized by planting seedlings with strong taproots that are large in proportion to the size of the tops and that contain much stored food.

Plantings were made at two locations: (1) On recent sandy alluvial soil in an intermontane valley in the Santa Rosa Mountains, in Riverside County, California. The Santa Rosa planting is in a mountainous mediterranean climate. (2) On primary heavy grassland soil near Capistrano, Orange County, California. The Capistrano planting is in a coastal mediterranean climate, with moderately cool summers. Precipitation during the experimental period was at or above normal.

Seedlings were planted in natural soil in holes dug by shovels to a depth just sufficient to accommodate roots without bending. Soil was filled back into holes and tamped by shovel and by hand. Around each plant a ring of soil was thrown up to form a basin; subsequent waterings were made in these basins from tank wagons. At Capistrano domestic tap water was used; at Santa Rosa water from a surface reservoir was used. Where vitamin B<sub>1</sub> was used in the experi-

<sup>1</sup> Field and clerical assistance was furnished by the Works Projects Administration.

TABLE 1  
PERCENTAGE SURVIVAL OF CONTROL PLANTS AND VITAMIN B<sub>1</sub> TREATED PLANTS AT THE SANTA ROSA SITE IN  
RIVERSIDE COUNTY, CALIFORNIA

Species	Number of plants		Amount of vitamin B <sub>1</sub> solution* applied (total per treated plant)	Percentage survival of plants on different dates								
	Control	Treated		June, 1939		Oct., 1939		June, 1940		Dec., 1940		
				Control	Treated	Control	Treated	Control	Treated	Control	Treated	
<i>liters</i>												
<i>Chilopsis linearis</i> ..	12	13	44	100	100	83	75	83	75	83	58	
<i>Fraxinus velutina</i> ..	64	66	40	91	85	74	69	70	59	37	23	
<i>Gleditsia triacanthos</i> ..	58	60	40	88	73	67	61	61	57	25	32	
<i>Juglans hindsii</i> ...	7	7	44	100	100	100	100	100	100	86	86	
<i>Prosopis juliflora</i> ..	41	39	44	95	92	74	64	55	39	42	29	

\* The solution had a concentration of .05 mg crystalline vitamin B<sub>1</sub> per liter

ment, it was added at the rate of .05 mg per liter of water.

Species listed in Table 1 were planted April 6 to 15, 1939. All these plants received water at planting time and two weeks later. On these two occasions no vitamin was added. On May 17, 1939, vitamin solution was applied to basins of plants listed in Table 1 as treated plants. On the same date coordinate applications of water were made to control plants. Applications similar to those given May 17, 1939, were repeated June 8, July 10 and August 8, 1939. No further applications were given after August 8, 1939. The total amount of the vitamin solution added to the basin of each of the plants receiving the vitamin is shown in Table 1.

For the Santa Rosa site, Table 1 shows the survival of control plants and of treated plants during 1939 and 1940. The differences between the new shoot

received coordinate applications of water to which no vitamin was added. Applications of water (no vitamin added) to control plants and of vitamin solution to treated plants were given on May 1, May 24, June 20, July 20 and August 14, 1939. No further applications were given after August 14, 1939. Total amount of the vitamin solution added to the basin of each of the plants receiving the vitamin is shown in Table 2.

Table 2 shows the percentage survival of control plants and of treated plants in the test at Capistrano. No significant differences were found in the new growth of the treated plants and of the control plants at the Capistrano site.

**Conclusions:** For the plants tested, no marked beneficial effects were found in the initial survival or initial growth rate by adding vitamin B<sub>1</sub> in water (in concentration of .05 mg per liter of water) to the soil sur-

TABLE 2  
PERCENTAGE SURVIVAL OF CONTROL PLANTS AND VITAMIN B<sub>1</sub> TREATED PLANTS AT THE SAN JUAN CAPISTRANO SITE IN ORANGE  
COUNTY, CALIFORNIA

Species	Number of plants		Amount of Vitamin B <sub>1</sub> solution* applied (total per treated plant)	Percentage survival of plants on different dates							
	Control	Treated		July, 1939		Feb., 1940		July, 1940		Jan., 1941	
				Control	Treated	Control	Treated	Control	Treated	Control	Treated
			liters								
<i>Acacia farnesiana</i> . . . .	18	18	48	100	100	100	100	100	100	100	100
<i>Chilopsis linearis</i> . . . .	27	27	98	100	100	36	98	98	98	93	89
<i>Juglans hindsii</i> . . . . .	26	26	98	100	100	100	100	100	100	100	100
<i>Juglans hindsii</i> × <i>J. regia</i>	10	10	98	100	80	100	80	100	80	100	80
<i>Olea verrucosa</i> . . . . .	9	9	98	100	100	100	100	100	100	100	100
<i>Prosopis juliflora</i> . . . .	27	27	98	100	100	93	100	93	100	93	100
<i>Simmondsia californica</i> .	27	27	48	100	100	89	81	89	70	89	70

\* The solution had a concentration of .05 mg crystalline vitamin B<sub>1</sub> per liter.

growth of the treated plants and of the control plants were not significant at any time during the test at Santa Rosa.

The species listed in Table 2 were planted April 10 to 20, 1939. The plants grown at this Capistrano site differ in their treatment from those of the Santa Rosa site. At the Capistrano site vitamin solution was applied immediately after planting to the basins of treated plants. Control plants at planting time re-

rounding the plants. The data on survival suggest that added vitamin B<sub>1</sub> may have had, under the conditions of the experiment, an adverse effect on the survival of some of the species tested.

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## TACONIC ALLOCHTHONE AND THE MARTIC THRUST

THE significance of the stratigraphic contrasts in the Ordovician sediments of the Taconic Allochthone and the autochthone of the Champlain Belt in western New England and eastern New York long has been appreciated.<sup>1</sup> The fauna of the "Martinsburg shale" at Harrisburg, Pennsylvania, as listed by Stose,<sup>2</sup> includes "Deepkill" and "Normanskill" graptolites that are known only in the allochthonous Ordovician shale facies in New York, Quebec and Newfoundland. Inasmuch as the shales in Pennsylvania lie in the Great Valley belt of lower Ordovician equivalent carbonates, just as the Taconic Allochthone lies on carbonates of the Champlain Belt, it seems probable that the lower Ordovician shales at Harrisburg are in an outlier of thrust sheet. They may be in a klippe of the Martie overthrust sheet, the sole of which forms a continuous but sinuous fault line some 30 miles southeast of Harrisburg<sup>3</sup>; the minimum displacement would be comparable but less than that of the Taconic Thrust in the latitude of Albany.<sup>4</sup> Suggestion that ultrabasic rocks in the Piedmont are comparable to those east of the Green Mountains in the Taconic Allochthone has been stated.<sup>5</sup>

The writer has re-examined the Arvonian slate in the Martie thrust block in Virginia. Ordovician fossils have been collected from the slate<sup>6</sup> and from the similar

Quantico slate near Washington,<sup>7</sup> and both slates have been correlated with the Peach Bottom slate of Pennsylvania.<sup>8</sup> The Arvonian basal quartzite clearly unconformably overlies granite gneiss intrusive in the Wisahickon schist,<sup>9</sup> the latter in the main belt of the Glenarm series, demonstrating the pre-late Ordovician age of the Glenarm, and suggesting that it is Pre-Cambrian. The magnitude of the thrusting across the paleogeographic Quebec Axis would account for the contrast between the Paleozoic sedimentary sequence in the Martie thrust block and the contiguous autochthone.

A complementary induction is that the Manhattan schist and subjacent Inwood marble and Fordham gneiss and marble in New York, which have been uniformly correlated with the Glenarm sequence, lie above the sole of the Taconic-Martie thrust. Thus a thrust should pass north of the continuants of the New York City rocks and south of the gneisses of the Hudson Highlands, on which an autochthonous section is preserved.<sup>10</sup> The intense mechanical alteration of the Cambro-Ordovician carbonates of the autochthonous sequence on the south flank of the Highlands is compatible with the view that they lie below but near the sole of the thrust. The Taconic thrusting accompanied the Taconian Revolution, and is certainly pre-late Silurian, probably pre-Silurian.<sup>11</sup>

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## SCIENTIFIC APPARATUS AND LABORATORY METHODS

### THE DETERMINATION OF AMINO ACIDS OF THE DEXTRO OR UNNATURAL CONFIGURATION

THE increasing interest in the occurrence of amino acids of unnatural configuration warrants the preliminary description of a simplified method for their quantitative determination. The general usefulness of the d-amino acid oxidase of Krebs<sup>1</sup> as a specific reagent for this purpose has been demonstrated by Lipmann, Behrens, Kabat and Burk.<sup>2</sup> Whereas, their procedure is dependent upon the measurement of oxygen consumption in the Warburg apparatus, the same

result may be accomplished by determining with the highly sensitive reagent, 2,4-dinitrophenylhydrazine, the alpha keto acid formed in the enzyme reaction. This method which has proven extremely rapid necessitates only the use of an incubator and a colorimeter.

The enzyme oxidation is carried out by placing 1 to 2 ml of the unknown solution, adjusted to pH 8.0, in a 125 ml erlenmeyer flask. 2 ml of the d-deaminase<sup>3</sup> in M/60 sodium pyrophosphate at pH 8.0 are added, the flask quickly flushed out with a slow stream of oxygen and tightly stoppered. After incubation at 38° (without shaking) the mixture is transferred quantitatively with gentle suction into a 10 ml volumetric flask containing 1 ml of 20 per cent. trichloroacetic acid. The

<sup>1</sup> Arthur Keith, *SCIENCE*, n. s., 35: 310, 1912.

<sup>2</sup> G. W. Stose, *Bull. Geol. Soc. America*, 41: 640-641, 1930.

<sup>3</sup> G. W. Stose and A. I. Jonas, *Pennsylvania Geol. Surv., 4th ser., Bull.*, C87: 149-158, 1939; Ernst Cloos, *Bull. Geol. Soc. America*, 51: 860-861, 1940.

<sup>4</sup> G. M. Kay, *Bull. Geol. Soc. America*, 48: 286, pl. 5, 1937; C. Schuchert, *ibid.*, 48: 1028, 1937.

<sup>5</sup> H. H. Hess, *Bull. Geol. Soc. America*, 51: 1996, 1940.

<sup>6</sup> N. H. Darton, *Amer. Jour. Sci., 3d ser.*, 44: 50-52, 1892.

<sup>7</sup> H. A. Krebs, *Biochem. Jour.*, 29: 1620, 1935.

<sup>8</sup> F. Lipmann, O. K. Behrens, E. A. Kabat and D. Burk, *SCIENCE*, 91: 21, 1940.

<sup>9</sup> T. L. Watson and S. L. Powell, *Amer. Jour. Sci.*, 4th ser., 31: 36-41, 1911.

<sup>10</sup> A. I. Jonas, *Virginia Geol. Surv., Bull.* 38: 25, 1932.

<sup>11</sup> Stephen Taber, *Virginia Geol. Surv., Bull.* 7: 41, 1913.

<sup>12</sup> C. P. Berkey and Marion Rice, *New York State Museum Bull.*, 225-226: 62-64, 1921.

<sup>13</sup> G. M. Kay, *op. cit.*, 287-288; *Bull. Geol. Soc. America*, 51: 1932, 1940.

<sup>14</sup> E. Negelein and H. Bromel, *Biochem. Zeit.*, 300: 225, 1939, Step 1.

solution, which quickly flocculates, is diluted to volume and filtered.

To 1 to 5 ml is added 1 ml of 2,4-dinitrophenylhydrazine, half-saturated in N. HCl. After 10 minutes 10 ml of 2 N. NaOH are added and the solution diluted to 25 ml and read in the Klett-Summerson<sup>4</sup> photoelectric colorimeter using the green filter number 52. The blank value (zero time of incubation) is subtracted and the amount of keto acid is read from a calibration curve in order to calculate the content of d-amino acid.

With the more slowly reacting amino acids longer time of incubation or decreasing amounts of the unknown solution have made it possible to obtain maximum values, as shown by the following recoveries. With 10 micro mols of d-alanine 98 per cent was recovered as pyruvic acid in one hour and with 10 micro mols of d-phenylalanine 85 and 98 per cent. were recovered in 3 and 4 hours, respectively. Using only 5 micro mols of the latter a value of 103 per cent. was obtained in 3 hours of incubation.

The method described has proven particularly useful in determining the unnatural amino acids in various biological materials such as tissue hydrolysates and urine even in the presence of large amounts of members of the levo series. The acyl derivatives in urine have also been readily determined after submitting the samples to a preliminary hydrolysis. Its successful use in other instances and with other amino acids is dependent only on the formation of a stable keto acid and the ability of this keto acid to yield a colored 2,4-dinitrophenylhydrazone in alkaline solution. Other aspects of the use of this method and the results obtained will be described in detail elsewhere.

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## A NEW METHOD OF PLANT PROPAGATION<sup>1</sup>

A NEW method of rooting plant cuttings without sand, peat, soil or other solid media has been under investigation since early January of this year. Based on the principle that cut stems suspended in the very moist atmosphere of a specially constructed box can develop perfectly normal roots, the method has already given promising results.

The experimental boxes are approximately 3 feet tall, 2 feet wide and 1 foot deep. Each box has a glass front and back; the former is set in grooves so that it can be opened to permit air circulation, and the latter is kept closed but enables observation of root develop-

<sup>4</sup> The author is indebted to Mr. R. J. Bott of the Will Corporation for the loan of an extra Klett-Summerson photoelectric colorimeter for the purpose of working out this method.

<sup>1</sup> Journal Series paper of the New Jersey Agricultural Experiment Station, Rutgers University, department of plant pathology.

ment and of the moisture content in the back of the box. One-inch square removable shelves, made of ordinary builder's lath, are placed in a horizontal position about half-way in the box. A half-inch opening is left between shelves, and vertical wooden strips are nailed on the sides of the box in front of the shelves to hold the shelves in place. A large piece of sheet rubber, with holes of the size of the cuttings to be inserted, is fitted securely immediately behind the shelves. The rubber functions to confine the moisture in the back of the box where it is most needed and to keep the cuttings in place. A water trough in the upper back part of the box from which strips of absorbent cloth are suspended, supplies the moisture necessary to maintain the high humidity.

Successful rooting of a number of popular ornamentals, including *Achyranthes*, *begonia*, *chrysanthemum*, *coleus*, *geranium*, *perennial phlox*, *ivy* and *Philodendron* was achieved by this method in less than three weeks. Such plants were then successfully transplanted to soil in pots and have continued to develop normally. Dormant hardwood cuttings were placed in similar boxes in late January and early February. Vigorous roots developed in 6 to 8 weeks on *Hydrangea grandiflora*, *Deutzia crenata* and *Philadelphus coronarius*. These plants were also successfully transplanted to soil and have continued to grow normally.

In all the experimental boxes thus far used, root development was greatest in the vicinity of high moisture content and was either poor or entirely absent in those parts of the boxes where the atmosphere was relatively dry. With improvements in methods of maintaining a saturated atmosphere in the vicinity of the cut stems in the back of the box, this new method promises to be useful not only to commercial growers but also to the amateur propagator. The special type of box in which the present investigations were conducted is tentatively called the "Rutgers Aero-propagator."

P. P. PIRONE

NEW JERSEY AGRICULTURAL  
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## BOOKS RECEIVED

- Bicentennial Conference, University of Pennsylvania. *Cytology, Genetics and Evolution*. A symposium. Pp. 168. Illustrated. \$2.00. HENDERSON, LAWRENCE J. *The Study of Man*. Pp. 22. \$0.25. GREGORY, WILLIAM K., B. HOLLY BROADBENT and MILO HELLMAN. *Development of Oocclusion*. Pp. 72. 19 figures. \$1.50. University of Pennsylvania Press.
- ELDER, ALBERT L. *Laboratory Manual for General Chemistry*. Pp. x+259. Illustrated. Harper. \$2.00.
- GEIER, MARY C. *Oceanography of the North Pacific Ocean, Bering Sea and Bering Strait; A Contribution toward a Bibliography*. Pp. xxii+290. University of Washington, Seattle.
- LOEB, LEONARD B. and JOHN M. MEEK. *The Mechanism of the Electric Spark*. Pp. xiii+186. 43 figures. Stanford University Press. \$3.50.

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## ASPECTS OF MODERN PSYCHOLOGY<sup>1</sup>

By Dr. CHARLES S. MYERS

ENGLAND

Two hundred years ago psychology had no independent existence. But it was fast developing in importance and towards differentiation from the universe of philosophy to which it then belonged. In the year 1740, Berkeley and Hume were still living; Kant was in his teens; Locke, Malebranche and Leibnitz had not long since died, and the elder (James) Mill, Herbart and Lotze were yet unborn. Hitherto the concern of philosophers with what was to become psychology had had chief reference to their speculations upon the nature of knowledge and understanding and

upon the relations between mind and matter. But now their interests and observations were becoming increasingly psychological in other directions; and they were fore-shadowing views and attitudes which were to achieve prominence and importance throughout the history of psychology after its emancipation.

It was the mathematical and biological sciences that helped finally in the birth of psychology as a separate field of study and as an experimental science; they likewise played a part in the emergence of political economy and education, respectively, also out of philosophy. After a sterile mathematical treatment by Herbart of the higher mental processes in the early

<sup>1</sup> Address delivered at the Bicentennial Celebration of the University of Pennsylvania, September, 1940.

years of the nineteenth century, came Fechner's more attractive mathematical study of the relation between sensation and stimulus. At the same time Flourens, followed by Helmholtz, Hering and others, was applying the methods of physiological experiment to the study of the functions of the central nervous system and of the sense-organs. Wundt, who had taught physiology at Heidelberg for seventeen years under Helmholtz, came to take an increasing interest in philosophy and psychology on the transfer of Helmholtz in 1871 to the professorship of physics in Berlin. In 1875 he was offered a professorship in philosophy in Leipzig. At that university, Fechner, like Helmholtz and Wundt, a graduate in medicine, had been working, at first occupying the chair of physics until a long illness enforced his retirement. Thereupon he took up the study of philosophy and psychology, with especial devotion to psycho-physics and esthetics. With the practical aid thus received from mathematics and physiology, together with the motherly support of philosophy, Wundt founded at Leipzig the first "institute" of psychology—the first laboratory of experimental psychology. Although formally established in 1879, his institute was not recognized by the university until 1886.

In France the encouragement of experimental psychology came not so much from physiologists and their interests in sensation and in sensori-motor response, as from medical clinicians engaged in the treatment of disorders of personality, in the study of hypnotism and in the problem of the mentally defective. It was thus that the early work of the first psychological laboratory in Paris came to center about suggestion, fatigue and intelligence. These problems, although emanating from medical practice, received experimental investigation in a purely normal, purely scientific, atmosphere.

To Wundt at Leipzig, mainly on account of his keenness for experiment, and partly because at that time Germany was educationally their "spiritual home," flocked numbers of American students who were later to become the leading psychologists in this country: from England he received but two pupils, Titchener and Spearman, who afterwards achieved distinction in the subject. Of all these Titchener, who throughout the long tenure of his professorship at Cornell retained his British nationality, alone remained faithful to the main articles of faith emanating from Wundt's institute. For Titchener as for Wundt, psychology's task was to analyze mind, in the fashion of the chemist, into its simplest components and to re-synthesize these elements under experimental conditions; for him the elements consisted of sensations, images and feelings.

The living mind soon began also to be systematically

studied in much the same way as the living body; and this application of the biological standpoint to psychology quickly led to a differentiation of the subject into various branches according to the aspect from which it was being thus scientifically investigated. Initially, as we have seen, there had arisen *psychophysics* and *physiological psychology*—each directed to discover the relations between mental, neural and physical processes. Encouraged by the new doctrine of evolution, *animal psychology* rapidly came to the fore; and simultaneously came the study of the development of the mind in the human being—during infancy, throughout childhood and adolescence—and its regression in old age, *i.e.*, *genetic psychology*. Next came the study of mental differences between the races of mankind (*comparative psychology*, as it is sometimes called), the study of the mental life of communities and their institutions (*social psychology*) and the study of mental differences between human individuals (termed by one of its founders *differential psychology*).

In Great Britain the application of scientific psychological methods to the last-named study, of individual mental differences, is immortally associated with the name of Francis Galton; and in the United States of America with that of James McKeen Cattell, whom, now in his eightieth year, it is especially fitting to mention on the present occasion because of his connection with the University of Pennsylvania. Cattell was one of Wundt's earliest students. There is a story told of him that one day he approached Wundt, saying "Herr Professor, you need an assistant, and I will be your assistant." And Wundt's first assistant in the Leipzig institute Cattell became. In 1886, on his return to America, Cattell lectured at the University of Pennsylvania and here in that year laid the foundations of a psychological laboratory, although it was not until 1889 that the laboratory was adequately equipped and formally opened. The claim has therefore been made that this university possesses the oldest psychological laboratory in America that has had an uninterrupted existence from its foundation down to the present day. Here, too, the first American chair in psychology was founded: it was occupied by Cattell until, in 1891, he went to Columbia University, where he established another psychological laboratory.

Professor Cattell's interests lay not in introspection, one of the main pillars of the Wundtian school, but in the psycho-physical and statistical problems underlying mental measurement—interests which have been continued by Professor S. W. Fernberger, who occupies a professorial chair here to-day. They lay especially in the study of individual mental differences as revealed and measurable in human behavior; and these originated experimentally in the "personal

equation" which had for some time disturbed the observations of astronomers and had received close study in the early years of the Leipzig laboratory under the form of "reaction times." It became Cattell's aim to estimate human capacities: indeed he was the first to use, exactly fifty years ago, the now familiar expression "mental tests," urging with prophetic insight their future importance. His work, thus begun at the University of Pennsylvania, paved the way for the later "schools" of behaviorism and factorial analysis.

Yet another branch of psychology, which so far I have left unmentioned, with the early development of one aspect of which the University of Pennsylvania has again been intimately concerned, is *abnormal psychology*. This university was the first to found a "psychological clinic" for the study and treatment of mentally abnormal children. It was formally established here by Professor Lightner Witmer in 1897. Witmer, like Cattell whom he followed in the directorship of the psychological laboratory and in the chair of psychology at this university, is happily also with us. Like him, Witmer received his doctorate from Wundt at Leipzig and, like him, his interests have been mainly centered in individual mental differences. But these differences have been of a psychopathic order, relating mainly to those revealed in the school-room or in the juvenile court. The success of his pioneer work is attested by the fact that "psychological clinics," or "child guidance clinics" as they are now often called, are to be found to-day in every community that can claim to be interested in its own social welfare.

Witmer's efforts afford an early example of a series of further, later, *applications* of psychology, not only to education, delinquency and medicine but also to other branches of sociology—to art, religion and especially to occupational life. One of his pupils, Professor M. S. Viteles, of the University of Pennsylvania, is one of the most distinguished "industrial" psychologists throughout the world.

It should not be a matter for surprise that the scientific, biological study of mind has opened out so many different aspects or branches of psychology. In biology, the science of the *living body*, a corresponding number of sub-divisions can be easily recognized. Biology comprises—botany and zoology, with their numerous sub-divisions into mycology, bacteriology, protozoology, helminthology, etc., up to anthropology; the different aspects of study indicated by physiology, pathology, anatomy and histology, together with embryology, genetics, bio-chemistry, neurology, cardiology and so forth; and their various "applications" to medicine, surgery, hygiene, agriculture, etc. It is therefore no disparagement to psychology, the science of the *living mind*, that, with its differentiation as a separate discipline of knowledge and re-

search, we are able similarly to record the development of physiological, animal, comparative, genetic and differential psychology, psycho-pathology (i.e., medical or abnormal psychology), educational psychology, industrial (or, better styled, occupational) and social psychology, and the special relations of psychology to religion, art, crime, etc.

The one important branch of psychology which finds no real analogy on the biological side is "differential psychology." As a natural science, psychology studies individual *mental* differences from the functional standpoint—in order to arrive at a clearer idea of the nature of mind. *Average* memory, *average* threshold, *average* imagery, *average* personality, "mind in general," these pall in interest compared with the psychological study of the *individual* and of *individual* differences. To the biologist, on the other hand, individual *bodily* differences among the members of a species have so far offered little or no attraction from the standpoint of function. His only interest in them comes with an approach from the genetic side—the inheritance of characters and the acquisition of new characters through environmental changes. The biologist in the past, like the physicist, has been largely interested in classification. Classification was for Aristotle a main *raison d'être* of science; the individual peculiarities of cases had therefore to be ignored so far as possible; cases had to be placed as comfortably as possible in the nearest class or type into which they would fit.

It was in imitation of this early procedure of the natural sciences and in the desire to make psychology a branch of natural science, that neither Wundt nor Titchener, with their accent on introspection, took any real interest in individual mental differences. Moreover, despite their devotion to introspection, they did not wish to accentuate the necessarily personal, "private," feature of the *mental* objects of psychological study, compared with the "public" character of the *material* objects of physical and biological study. For the same reason (introspection here being impossible or unreliable) animal and child psychology did not interest them; nor could they find room for abnormal and applied psychology, as they were undertaking pioneer work for the recognition of a pure science.

As has been pointed out, psychology shows at least as many different aspects, judged by the number of its branches of study and the diversity of its applications, as does biology. Appealing as they must to an enormous variety of interests and talents both among psychologists and biologists, they can in every way justify their existence. But in the case of psychology, there is another series of aspects which finds little or no analogy in biology nor indeed in any other natural science. These aspects reflect individual differences in

attitude, of a more profound philosophical character, among the past and present leaders of the subject, which have resulted in the development of a number of *schools* of psychology—some now defunct or moribund, others still active and, until recently at least, in violent opposition to one another. To the outside world it may seem that, if psychology is to be regarded as a natural science, there can be no reason for the existence of these antagonistic schools, unless it be the unsettled state of the whole subject or of the particular branches of it with which they deal, or the fanatically narrow and intolerant mentality of those who are at their head. Wundt provided a striking example, *more Germanico*, of this dictator-like attitude of a school head; it was faithfully copied by Titchener in America, and was later adopted in Vienna by Freud. A young student of mine happened once to mention to Freud the name of Alfred Adler, one of his most distinguished pupils, who had been driven from his school because of disagreement on scientific matters: "ich kenne ihn nicht" was the reply that he received.

And yet, despite their radical differences of outlook, Freud, Jung and Adler have doubtless had equal success in their medical practice. In the matter of treatment, therefore, the extent to which "sexuality," the "collective unconscious" and "inferiority" play their roles, as variously advocated by the leaders of these three schools, would seem to be of secondary importance, compared with the enormous influences of suggestion and the revival, explanation and reintegration of repressed, distorted complexes. Each was neither by temperament nor by training a man of science. He attempted to build an incomplete system of psychology based fundamentally on the observation and treatment of psycho-neurotics. In the case of Freud, at least, this embodied a gloomy, cheerless view of life, a life of incessant conflict and repression, in which consciousness was of relatively little concern or potency and was always being caught off its guard by the irresistible, subterranean, hostile, unconscious, mental forces of the libido. Each leader poured forth floods of hypotheses and explanations, and these attracted (strangely like psychical research) literary people and physicists rather than those who had received a systematic training in psychology. Freud himself once said about certain views that he had proposed, "I am neither convinced myself nor am I seeking to arouse conviction in others. More accurately I do not know how far I believe in them." Starting with tentative hypotheses, he would too often raise them quickly to the status of important principles, and later be equally ready to abandon them. Loose terminology, needless anthropomorphisms and ridiculously wild generalizations have, from the scientific standpoint, been the ruin of these men of genius.

It remains for the future to sift out and to combine into an integrated system what is, and will undoubtedly be found to be, true in the teachings of these three schools—of psycho-analysis, analytical psychology and individual psychology. Assuredly their leaders' influence will never die; psychology will never be the same as it would have been, had they never lived. We know now from their labors that there is no hard and fast line to be drawn between the normal and the psycho-neurotic—just as we know now that the people of intelligence shade imperceptibly into the mentally deficient. Our scientific concepts of the unconscious and of mental inhibition or repression have become vastly changed and widened; our old ideas of the relative importance of reason and emotion in determining human conduct are now almost reversed; and such current popular expressions as "wishful thinking," "extraversion" and "inferiority" attest the wide-spread influence of these schools of "depth" psychology. Who can read Freud's "Traumdeutung" without admiration for his original, ingenious and invaluable analysis of what he calls "the dream work"?

Yet another rival leader in psycho-pathology, Janet, has developed concepts which will be everlastingly useful in general psychology, those, for example, of dissociation and of psychic stress and tension. But some schools of psychology are not to be ascribed to the particular genius—or to the failings—of their founder. They are inevitable, because inevitably psychology can be approached from very different standpoints with different aspects of truth peculiar to each. These different approaches are beneficial to the progress of the entire subject, because they enable quite different paths to be cut with the aid of quite different weapons. The weapon may be sometimes borrowed from physiology, psychiatry, education, zoology or mathematics, experts in which are attracted to psychology often without having received adequate training in it. Their contribution is frequently helpful in a circumscribed field: their failure comes when, founding a school, they attempt to extend the fruits of their narrow specialization to gathering a wider harvest—when they come to believe that the weapon which they are using is the sole weapon by which progress is possible, whatever be the psychological path taken.

There have been psychologists like William James, whose outlook was too wide and catholic, whose weapons were too varied, to found a school; of the schools that have developed since his time, many could have turned to him, each claiming encouragement and support. G. E. Müller, the beauty of whose experimental methods in psychology has never been approached, was another who did not attempt to establish a school. Not less distinguished a psychologist, Stumpf, left behind him these words:

I have never endeavored to found a school in the strict sense, and have found it almost pleasanter, certainly more interesting, to have my students reach different conclusions than to have them merely corroborate my theories.

The inadequacy of the early schools of Wundt and Titchener was soon recognized. They both did admirable work, and were often criticized unjustly for views which they could never literally have accepted. Broadly speaking, they regarded the mental world as the physicist regarded the material world—as a vast mechanism driven by discoverable laws (among which those of association loomed large), analyzable into elements, and describable in abstract terms void of purpose, value or meaning. They regarded psychology, to use their own language, as the study of experiences considered as dependent on a central nervous system and on an experiencing person. They were distantly interested in the relation of the central nervous system to these experiences, but they made no attempt to bring the psychology of the experiencing person under scientific examination. As a natural science, psychology had discarded the soul; and with the soul went the self or ego, the most obvious discovery of introspection!

In the time of Wundt, atoms too small ever to be visible were the ultimate particles recognized by physicists. The latter, in accordance with the second law of thermodynamics, regarded the world as a huge mechanism running down after having been once wound up—as if it were the creation of an *engineer*. To-day mathematical physics, dealing with electrons and quanta, has entered the field. It regards the world as unsubstantial—as if it were the creation of a *mathematician*. The individual electron has no real separate existence: it is in this respect a mathematical fiction, sometimes needing to be regarded as a particle, sometimes as the center of a wave disturbance. The experimental physicist is in danger of being ruled by the mathematician, his discoveries having to be incorporated within an unreal world of mathematical relations connecting unimaginable entities. The pass to which mathematics has thus reduced physical science is the ultimate issue of its own procedure. The more exact a physical experiment, the more artificial, unreal and abstract it becomes. At each stage of analysis, as lower and simpler levels are reached, something is lost: for the whole is more than the sum of its parts. As by synthesis we pass upwards from what we have ultimately reached by analysis, new properties, new characters, “*emerge*” which are not in the parts: so the properties of water emerge from the union of hydrogen and oxygen, and the characters of the living emerge from those of the lifeless world; and so too conscious activity would be described as emerging from reflex activity, could we succeed in analyzing the

former into the latter. In such analysis ultimately a scheme of purely symbolical data is employed, conjoined by mathematics. Science, as thus engaged, has no concern with meanings or values, nor with history or purpose.

Psychology can do the same, it can pose as a natural science and reduce itself to mathematical symbols. But it can also pose as one of the humanities. It is perhaps this dual aspect of the subject that has attracted those who have achieved the greatest distinction in it. They have been men imbued with a love for experimental and analytical science combined with a love for living experience and for philosophy or the other humanities. And according to their major interest they have leaned rather to the mechanistic or to the humanistic standpoint. In Germany extreme regard for the latter standpoint has produced a school of *Verstehende Psychologie* under the successive leadership of Dilthey, Spranger and others, who have felt that for the true “understanding” of the individual human mind the principles not of natural science but, as they term it, of *Geisteswissenschaft* are needed, the latter starting with the totality of mental structure, the former with the study of physical elements. This school does not hope to reach more than broad types, ideal not real, of personality, culture, etc., by generalization and abstraction from the observation of individuals, the study of autobiographies and history, etc. Its real aim is the study of the *unique* individual and of the laws governing the individual, that will indicate, to use G. W. Allport’s words, “how uniqueness comes about,” corresponding to the objects of the study of history, religion, art, etc., to which psychology must ever furnish an important base.

The contrast between the ideals of this school and those of Titchener’s “existential,” “structural” or “introspective” school, as it has been variously named, could not well be greater. But however “scientific” its intentions and tenets, Titchener’s school did not, as a school, outlive its founder. However valuable, introspection and observation came to be regarded as insufficiently trustworthy for the discovery of mental elements. It became increasingly clear that structurally all mental experiences can not be analyzed into, and expressed in terms of a mosaic of sensations, images and feelings, and that learning and remembering (at all events where meaningful matter was concerned) depended on other important mental processes than on merely mechanical associations. Moreover, in the first place, it was felt, especially by psychologists in America, impossible to neglect the study of the “functional” aspects of mind—the study of the vital services rendered by consciousness to the organism in the adaptation of the latter to its physical and social environment, the special needs of the organism served by per-

ception, emotion, etc. Thus Dewey, followed by Angell, started in America the *functional* school of psychology, Jastrow stressing its *genetic* aspect.

In the second place, the *dynamic aspect* of mind was also stressed, by Woodworth, as deserving of closer study. There is far more in a percept than a "bundle" of sensations, far more in thought than a train of images; and there is far more in perceiving or thinking than mere percepts or thoughts. A part of that "more" consists in the character of the operation or "act," and in the direction and determinants of the responsible forces of mental activity. Thus we are led to study the roles and the varieties of "drives" and motives, interests and attitudes, instincts and habits, alike in experience and in behavior, and the general study of conduct in relation to the unconscious, as well as to the conscious, mind. "Dynamic" psychologies arose which originally had for their object the discovery of a relatively small number of basic elementary units in the various forms of instincts, propensities, tensions, needs or motives—common, it was believed, to all individuals and adequate, it was hoped, to account for the unique conduct and the unique personality of each. But the insufficiency of this simple "scientific" standpoint is becoming increasingly recognized, as has been lately emphasized by G. W. Allport in his admirable volume, "Personality: a Psychological Interpretation." The complex systems of motives in later life are functionally unrecognizable in their crude infantile and childhood origins.

Thus came about a tendency, even also among experimentalists, to start from and to stress the unique, unitary self or personality, with its drives, needs, interests, traits, attitudes and purposes, and its universe of meanings and values. This tendency arose also from the realization that living processes, whether mental or bodily, can not be *completely* studied from the synthetic direction, owing to their possession of the character of "goal-seeking." It led to the schools of *hormic* (or *purposive*) and of *personalistic* psychology founded by Nunn and McDougall and by Stern respectively. For Stern the "person" was of a psychophysically "neutral" nature—neither psychical nor physical but transcending each: thus he hoped to bridge the gulf between abstract scientific knowledge and psychical reality!

Such a revolt from the contemporary standpoint of natural science was bound to have its consequences on those who approached psychology from that standpoint. What is it, they asked, that prevents psychology from being treated as a natural science? It is because the characters of mind, as observed by introspection, are the *private* concern of the introspecting "subject." They can only be communicated to others by oral or written report, *i.e.*, by movements; they

can only be studied and measured by their actual expression, *i.e.*, by movements. Movements are like the other "objects" studied by natural science; they are the *public* concern of all who care to attend to them. Natural science has to exclude, as Piéron well expresses it, what "can not become the object of collective experience." Why then, it was asked, should we not make psychology a natural science by studying exclusively the movements, *i.e.*, the behavior, of the individual in response to the stimulus and with regard to its environment? And thus arose Watson's *behavioristic school*, an extremist attempt of the animal psychologist to dispense with all reference to consciousness in any form.

With the same aim Pavlov and Bechterew in Russia started their schools based on their independent discovery of the "conditioned reflex." (This was also simultaneously and independently discovered by Professor E. B. Twitmyer, a member of the present staff of the psychological department in the University of Pennsylvania.) They held firmly to the idea that all mental responses could be derived from the reflex. They were fully satisfied with the sufficiency of the old doctrine of associationism to account for mental integration, the learning of ideas and of skills and their reproduction. What could be simpler than to construct an analogy between the higher neurones, united one to the other by synapses, and ideas, united through association? But extreme behaviorism, through its unreflecting imitation of the procedure of natural science, is confronted with the same abstract, unreal situation as physics—a situation which is logically and mathematically correct, but which is not the teaching of common-sense every-day life. It is forced to maintain the two absurd standpoints that consciousness is of no biological, functional, significance whatever in human and animal life; and that the highest, noblest mental responses and personality itself are nothing more than the mechanical integration of the lowest and simplest reflexes.

Eddington has remarked of physics, "we rig up some delicate physical experiment with galvanometers, etc., specially designed to eliminate the fallibility of human perceptions; but in the end we must trust to our perceptions to tell us the result of the experiment." So too, in fact, it is impossible for the extreme "behaviorists" to dispense entirely with consciousness. Their successors, indeed, the milder "neo-behaviorists," could not fail to recognize the part which their own conscious selves play in their interpretation of their animals' behavior; as they admit, the introspections of a conscious subject are merely replaced by the interpretations of a conscious experimenter. Indeed by one of these "behaviorists" mental processes have been freely accepted as "inferred determinants of behavior

which ultimately are deducible from behavior," instead of being as the "mentalist" assumes, "essentially inner happenings primarily available to introspection only." A broadly "behavioristic" attitude has spread widely among experimental psychologists during recent years. But the tenets of the school are far from being accepted in such an extreme sense as its founders desired. "Conditioning" in the laboratory proves to be definitely different from "association" in every-day life. There is a growing recognition, too, that if the "behaviorist's" observations are to be confined exclusively to animals and infants, experimental conditions must often be artificial and unnatural; while the urges, drives and tensions studied must relate largely to sex and food, to the exclusion of the higher moral and artistic needs and creative activities of man.

Allied to this school is that of *operationism*, recently welcomed from the side of physical science, ac-

cording to which a concept can only be defined in terms of some objective technique, *e.g.*, by the corresponding set of "operations" that have been designed to assess it. For many years psychologists engaged in mental testing have had to be content with defining "intelligence" "operationally"—as being what is measured by intelligence tests. Adherents of this school have attempted to give similar operational definitions to other mental terms, thus, in *quasi*-behavioristic fashion, hoping to establish a psychology which will give an objective rendering of all subjective terminology. It is possible, but, as I have urged, it is insufficient, to regard psychology as a science in which the "private," personal, nature of mental experience is transformed into arrays of symbols which have been derived from "publicly" observable events, *i.e.*, behavior.

(To be concluded)

## IS THIS SUCCESS?

By the late Dr. ROYAL N. CHAPMAN<sup>1</sup>

TO-DAY I shall be alone. So far as I know there is no one on the boat who would recognize me. Tomorrow the passenger list will be published, and then there will be introductions and interviews. It has come to the point where I find seclusion only on an airplane where the roar of the motors precludes conversation, on a train or on a day like this on a boat. It is a far cry from a youthful ambition for the life of a naturalist emulating Thoreau and Burroughs to a strenuous program of consultations and the direction of research.

It required a great mental adjustment to pass from a self-supporting student interested in the development of socialism to the direction of a research institution on which a great, highly capitalistic industry depends. It has meant the transition from the problem of choosing each meal according to the money in the pocket to the problems in which millions are won and lost. More than all else it has involved ideals,

the realization of which I once thought to be the object of my life.

A former college mate with whom I shared the struggle for advanced degrees in a well-known graduate school recently reminded me of one of our idealistic discussions, in the course of which I had expressed myself as to a salary which would satisfy all my financial ambitions. He called my attention to the fact that my present salary is ten times the maximum that was specified in those days of the graduate grind. He asked what it was all about. Had I forgotten that we had pledged ourselves to the exploration of nature, not for material wealth but for the discovery of her laws of the interrelationship of organisms? Did I no longer share that aversion for a materialistic world which spends half its time chasing the almighty dollar only to spend it on movies, motor cars and jazz? Was it not as true as ever that society must learn to use its leisure with books and nature rather than at horse racing and dancing, if a high order of civilization was to be maintained?

I have been searching for the answer to his questions in the snatches of time when I have been looking down from the clouds or across the sea. The question was presented anew day before yesterday when an interviewer began with one of those flattering introductions, saying that she was writing a series of articles for a well-known magazine on successful men, and that I was on her list. The interview was postponed, but it renewed my reflections.

After all, is this success—this crowding out of

<sup>1</sup> This essay by Dean Chapman was found among his papers after his death, December 2, 1939, at which time he was dean of the Graduate School of the University of Minnesota. It was written in December, 1938, when he was director of the Experiment Station of the Pineapple Producers Association of Honolulu, Hawaii, and while he was on the boat going from Honolulu to this country. It was on this trip that he received and accepted the offer to become dean of the Graduate School at Minnesota, which office he assumed in the summer of the following year, 1939. During his short term of office as dean of the Graduate School he took up again his early morning insect research on "little universes under controlled conditions" and happily returned, as far as the administrative duties of his office permitted, to a realization of the ideals of his youth's enthusiasm.

ideals by the high pressure of the modern world? Were the old ideals wrong? Did they belong to the past generation and was the gradual transition which crowded them out only an expression of nature's law of progress? Has this change indicated that I have been successful in keeping abreast with the modern world, or a weakness in giving up my ideals?

It all came about so gradually that I was not aware at any time of a decision that meant this change. All temptations which seemed to involve a sudden departure were turned down; and there was a series of them. But little by little it came about.

When I received my Ph.D. degree I accepted an instructorship with a salary of little less than an average clerk would receive, married a girl who believed in me and shared my ideals and who had been receiving a salary larger than mine. We worked together with enthusiasm, for she too had been an instructor in the same university. We studied the birds and insects of our neighborhood and began a detailed study of the animal population of a fresh-water lake.

Then war came. I was not accepted for active duty but discovered that my science could be applied to war-time industries. When the war was over there were demands that I continue my industrial activities. The university made the necessary adjustments, and week-end trips half way across the continent began. All vacation time was spent wrestling with industrial problems. Each one looked like an exception. It was worth thousands to the industry and would be solved in a few days or weeks. But there were no more vacations in the north woods where we used to travel by canoe and live in our little shelter tent, studying the things that were to be the object of our life work.

Through it all my university schedule was left inviolate. This other work was relegated to week-ends and vacations. But a change came in the university work also. Gradually I became involved in the direction of graduate students, and the undergraduate classes were shifted to other instructors. I became the head of a department. As time went on it was evident that these graduate students who came even from foreign countries were interested in the economic application of my work and not in my "ideals." They soon absorbed all my regular hours outside of class.

There were still two things left; a class of freshmen during three months each year who did most of their laboratory work in the field, and my own hours between four and eight in the morning. I enjoyed the enthusiasm and curiosity of the undergraduates and told them that there would be nothing in the course that would ever be worth any money to them, but that I hoped they would learn of other things in this world which are worth more than money. Life need never

lose interest for them, I said, for there were "books in running brooks." Possibly they were the only ones who believed me, for the dean and the president continued to ask for instances wherein I had saved thousands of dollars for industries, which they could put in their annual reports or their speeches to the commercial clubs. I think their ideals were like mine, but they were feeling the same economic pressure as I, and they were closer to its source.

Hemmed in by modern methods of transportation and communication, I couldn't enjoy the seclusion of a monk's monastery, so I made the Einsteinian substitution of time for space and had my monastery in a modern laboratory between the hours of four and eight in the morning. This meant no parties or theaters the night before, but it was my own time, before I had been tired by the daily duties of my position.

To be sure these hours were not adapted to field work, but I created artificial environments and put populations of insects in them which behaved like little universes under controlled conditions. And I studied them without interruption while the economically minded world slept.

The trips away got longer and the problems more involved. I crossed the Atlantic and the Pacific, went from the Arctic Circle to the Sahara Desert. Now the undergraduates have dropped out of the picture. My work is essentially administrative and the direction of research which is of more economic importance than ever. My time is so expensive that I can not afford to do anything that any one else can do for me. Interviews must be short in order to get them all in during the course of the day. I must make all decisions myself, for I have no colleagues with whom to consult. I sit alone with my judgment, but I am never alone with myself.

My wife has the social obligations that belong to our position and our home establishment and servants to preside over. In our new environment we are surrounded by strange plants and animals, but we have had no time to get acquainted with them. The ideals that I once had and tried to give to the freshmen seem to be gone. It is harder than ever to get up at four o'clock. The transition seems to have been made.

I am not unhappy in it all. I have become attuned to it. I find it hard to relax when I have a few minutes to myself. I shall probably enter into the activities of life on the boat while others will read books, because it is hard for me to let down.

The interviewer asks if she may tell the world how I achieved success; my college mate asks what it is all about. A former professor of mine said that success was the attainment of one's ideals. I look across the sea from my deck chair and wonder. Has the old order changed and is this the new? Is this success?

## SCIENTIFIC EVENTS

### GIFTS TO SCIENCE AND EDUCATION

THE annual report for 1940 of Dr. Frederick P. Keppel, president of the Carnegie Corporation, gives a list of large sums given or bequeathed for scientific and educational purposes during the period covered by the report. These include a new foundation with a capital of \$8,000,000 that has been established through the will of the late Charles E. Culpeper, of New York, for the support of charitable, religious and educational organizations. Significant additions to the resources of existing foundations have been made as follows: to the Kresge Foundation, \$7,650,000 from S. S. Kresge, of Detroit; to the Kress Foundation, \$1,000,000 from Samuel H. Kress, of New York; and to the Murry and Leonie Guggenheim Foundation, \$5,000,000 by bequest of Murry Guggenheim to enable its dental division to erect, equip and operate a dental clinic for the children of Greater New York. Eventually, a large part of the estate of Edward S. Harkness will go to the Commonwealth Fund.

Many of the largest gifts of the past year for educational purposes have centered about the Chicago area. From the estate of Mrs. Clara A. Abbott \$1,500,000 has been left to Northwestern University, and \$1,000,000 to the University of Chicago, for the advancement of medical, chemical and surgical science. The University of Chicago has also received \$2,000,000 through a bequest of the late Orson C. Wells for medical education and research. From the estate of Mrs. Margaret Gray Morton \$2,000,000 has been given for the erection and endowment of a hospital for medical research, to be the fourth unit of the Northwestern University Medical School at Chicago. Wesley Hospital is now constructing on this campus the third unit, made possible by a gift of \$1,660,000 from G. Herbert Jones. The Field Museum of Natural History during 1939 received gifts totaling over \$700,000. In addition to these benefactions, large gifts of real estate have been made by Albert D. Lasker and Marshall Field, III, to the University of Chicago.

Omaha's art museum, the Joslyn Memorial, has received a further gift of \$2,500,000 from Mrs. Sarah H. Joslyn. Among other large gifts reported are: from the estate of Frederick W. Vanderbilt, over \$1,500,000 to Vanderbilt University; from the estate of Dr. John M. Vincent, \$1,500,000 to Johns Hopkins University; from the estate of R. Wistar Harvey, an estimated \$1,000,000 to be divided between the Philadelphia Museum of Art and the Pennsylvania Hospital; and from the estate of Mrs. Cora Liggett Fowler, of St. Louis, \$1,000,000 for a hospital.

Announcement has recently been made in Cape

Town of provision for a trust fund valued at about \$1,000,000 under the will of the late Sir Abe Bailey, leading citizen of South Africa and one of the principal mine owners of the Transvaal. Its purpose is to encourage the teaching of Afrikaans in English schools, to send students, particularly Afrikaans, as visitors to England and other parts of the Empire, and to assist the Salvation Army.

### THE STANDARDS COUNCIL OF THE AMERICAN STANDARDS ASSOCIATION

THE Standards Council of the American Standards Association met in New York on April 10. The council which is in charge of all technical work reported progress on many projects of interest to business as a whole.

In line with the recently announced plans to speed up work on standards needed for defense production, it was announced that the following safety standards on toxic substances would be developed under the Emergency Procedure: Acetone, Azides (lead and sodium), Cadmium, Ether, Manganese, Tetrayl, TNT and Xylol. These and other safety standards are needed to help industrial concerns protect the large number of employees now being turned into jobs requiring contact with toxic or explosive substances. These projects will be developed as quickly as possible under the new Emergency Defense Procedure of the Association. Committees have already been appointed to do the technical work of drafting these standards.

At the request of the committee in charge of developing standards for toxic dusts and gases, the council approved adding a representative from the U. S. Bureau of Mines to this committee. The bureau is carrying on research work in the field which will be valuable to the committee in its future work.

Acting on advice of the Advisory Committee on Ultimate Consumer Goods which coordinates all work in the consumer field, a representative of the Mail Order Association of America was added to that committee. This association includes in its membership the 4 large mail order houses that do a country-wide business—Sears, Roebuck, Montgomery Ward, Spiegel's, and Chicago Mail Order. It naturally has a very vital interest in standardization work in the field of consumer goods. Its members are already active on a number of technical committees.

Still in the consumer field, the Standards Council approved starting a project to work toward more uniform methods of testing color fastness of textiles and to extend work on color fastness into fields not now covered. This work grows out of a need felt on the part of both consumer and retailer groups for some

adequate method of determining the relative color fastness of materials.

A safety code for dry-cleaning operations is planned. This code will deal with the mechanical hazards in dry-cleaning operations and with the toxicity of fumes. The National Association of Dyers and Cleaners has agreed to take leadership in the technical work.

Two standards of general interest to consumers have been initiated. One of these is to develop standards for household electric ranges covering definitions, methods of test, performance, durability, safety, etc. The other is to develop a similar set of standards for electric water heaters.

A progress report received from the committee on sizes for children's clothing indicates that the first standard in this field—body sizes for boys from kindergarten to junior high school—will soon be completed. This will constitute the first step in development of a more uniform and more accurate method of sizing girls' and boys' clothing.

The committee in charge of work in the mining field reported progress on a number of jobs. A preliminary draft code covering quarry operations, including open pit and strip mining, has been completed and will serve as a basis for the work of the committee developing the standards. Progress was reported also on the revision of a standard on electrical equipment in coal mines, on the revision of a standard on wire ropes for mines, and on revision of a standard for ladders and stairs for mines.

A subcommittee was appointed to study the present methods of protecting workers against health hazards arising from dusts and gases in mines.

#### THE MEMORIAL HOSPITAL, NEW YORK CITY

MEMORIAL HOSPITAL for the Treatment of Cancer and Allied Diseases will spend approximately \$130,000 on education and research concerning the cause and treatment of cancer during this year, according to the report of Dr. Cornelius P. Rhoads, director of the hospital.

New gifts are being sought for this purpose and about \$70,000 has recently been obtained toward the hospital's research budget. Contributors include Harry Payne Bingham, of New York; M. M. Rippa, of Miami Beach, Florida; Noel D. Sidford, of New York; Lucius N. Littauer, of New York; the Jane Coffin Childs Fund; the Commonwealth Fund; the Egbert C. Fuller Trust; the Holmes Foundation; the Pierre S. du Pont Fund; the J. J. Lerner Dental Fund; the Charles Lerner Research Fund; the Elise Strang L'Esperance Fund; the Research Corporation; Standard Brands; the Rockefeller Foundation, and the Community Trust. Some of these have made previous gifts for the purpose. A bequest also was

received from the estate of Lucy A. Kutz, of New York.

The Rockefeller Foundation recently renewed a grant of \$60,000 a year for two years, similar to the amount heretofore given by the General Education Board. This is earmarked for clinical and laboratory education and research, as well as for the training of nurses in cancer work.

The hospital conducts a broadly organized program of clinical and fundamental research into the cause, symptoms and treatment of neoplastic diseases. There are eight laboratory departments covering the natural sciences, each with its special staff of scientific experts and assistants. The research covers the field of pathology, chemistry, bacteriology, biology, physics and biophysics and includes study of radiation treatment with x-ray and radium. Particularly important experiments are being carried on in the field of chemical research, including vitamins, spectroscopy and hormones.

Much of the work of the ten clinical services also yields important cumulative data on results of various forms of treatment.

Important research is done in physics. The Department of Radiation Therapy is equipped with all approved apparatus, much of it original, including x-rays from 50 volts to 1,000,000 volts, full body x-radiation and telerradium therapy for the treatment of tumors by four grams of radium at a distance. The hospital has nine grams of radium in use. There are two low-voltage and five high-voltage x-ray therapy units and one Phillips contact treatment tube.

#### AWARDS OF THE SOCIAL SCIENCE RESEARCH COUNCIL

EIGHTY awards, amounting to \$75,000 for the academic year 1941-42, have been announced by the Social Science Research Council, New York City. The awards provide for study and research in the fields of economics, political science, sociology, statistics, political, social and economic history, cultural anthropology, social psychology, geography and related subjects.

Seven of the awards, carrying a basic stipend of from \$1,800 to \$2,500, plus travel allowances, cover post-doctoral research training fellowships to men and women under thirty-five years of age who possess the degree of doctor of philosophy or its equivalent. These fellowships are granted for the purpose of enlarging the research training and equipment of promising students through advanced study and field experience.

Thirteen appointments are pre-doctoral field fellowships which carry a basic stipend of \$1,800 plus travel allowance. The recipients are graduate students under thirty years of age who have completed

all the requirements for the Ph.D. degree except the thesis. These fellowships are intended to supplement formal academic study by opportunity for direct contact with the materials of social science not available in the classroom or library.

The remaining sixty awards are research grants-in-aid, designed to assist mature scholars in the completion of research projects already well under way. These grants average about \$450 and do not ordinarily exceed \$1,000. Twelve of these appointments were made through a special fund specifically granted for the purpose of assisting and encouraging the research of social science faculties in the South. The objectives and requirements for eligibility are the same as those governing the national grants-in-aid, but applications are restricted to fourteen southern states.

### ENGINEERING AWARDS IN GREAT BRITAIN

THE following awards for 1940 of the Institution of Mining and Metallurgy are reported in *Nature*: Consolidated Gold Fields of South Africa Limited Gold Medal to C. R. Julian for his paper on "Underground Mining at Rio Tinto, Spain"; Consolidated Gold Fields of South Africa Limited Premium of forty guineas conjointly to J. Spalding and T. W. Parker for their paper on "Air-Conditioning Plant at the Ooregum Mine-Kolar Gold Field"; William Frecheville Students' Prize of ten guineas conjointly to J. E. Denyer and K. C. G. Heath for their paper on "Mining and Milling Tin-Tungsten Ore at Mawchi Mine, Burma." The council has also elected H. K. Picard to honorary membership, in recognition of his distinguished services to metallurgy.

The awards of the premiums of the Council of the Institution of Electrical Engineers are: *Institution Premium*: C. F. Booth; *Ayrton Premium*: W. A. Cook; *Fahie Premium*: A. Fairweather and J. Ingham; *John Hopkinson Premium*: G. H. Rawcliffe; *Kelvin Premium*: C. E. R. Bruce and R. H. Golde; *Extra Premiums*: C. G. Garton, L. Gosland and W. F. M. Dunne, Professor Willis Jackson and A. E. Chester, Dr. R. Jessel, W. J. Mason and S. A. G. Emms, G. H. Metson, A. Langley Morris; *Wireless Section Premiums*: N. M. Rust, O. E. Keall, J. F. Ramsay and Dr. K. R. Sturley (Ambrose Fleming Premium), C. A. Mason and J. Moir, Dr. R. H. Barfield; *Meter and Instrument Section Premiums*: Dr. A. E. W. Austen and Dr. S. Whitehead, A. J. King, Dr. R. W. Guelke, C. R. Maguire and Dr. R. A. Scott; *Transmission Section Premiums*: F. R. Perry (Sebastian de Ferranti Premium), Dr. C. Dannatt and R. A. Polson.

### DEATHS AND MEMORIALS

DR. JAMES WATERMAN GLOVER, James Olney pro-

fessor of mathematics, emeritus, at the University of Michigan, died on July 15 at the age of seventy-two years. Dr. Glover had been connected with the university since 1895 when he joined the faculty as instructor of mathematics.

DR. ALADINE CUMMINGS LONGDEN, since 1926 professor emeritus of physics at Knox College, Galesburg, Ill., died on July 12 at the age of eighty-four years. He joined the faculty of Knox College in 1901.

DR. OLAF ANDERSON, professor of petrographic analysis at the Stevens Institute of Technology, died on July 18 at the age of fifty-seven years.

DR. ARTHUR ALBERT WEDEL, specialist in the subsurface stratigraphy of the central Southern States, died on May 7 at the age of forty-three years.

PROFESSOR A. KRYSTOFOVICH, of Leningrad, has written to inform us of the death in her fifty-second year, on April 12, of Dr. Nina V. Pimenova, paleobotanist and geologist to the Geological Institute of the Ukrainian Academy of Science, Kiev, and lecturer on paleobotany in the State University, and on May 5, in his eighty-fifth year, of Dr. Alexander A. Brauner, director of the Zoological Museum of the Odessa State University, Ukraine, known for his work in the zoology and zoogeography of the U.S.S.R.

DR. PETER VAN DE KAMP, of the Sproul Observatory of Swarthmore College, writes: "A letter received from the Netherlands a few days ago mentions the death of Professor Leonard Salomon Ornstein in Utrecht. Professor Ornstein was born in Nijmegen, Holland, on November 12, 1880. He studied at the University of Leiden, where he was assistant in theoretical physics and received the doctor's degree in 1908. A year later he was appointed lecturer at the University of Groningen; in 1915 he became professor in theoretical physics at the University of Utrecht and was appointed director of the physical laboratory in 1922 as successor to W. H. Julius. His field of study included molecular theory, heat, electricity, optics and liquid crystals. Ornstein's death at the early age of sixty years comes as a shock, since only recently a letter was received in which he reported himself as being in good health."

THE *Journal* of the American Medical Association reports that special ceremonies to dedicate a medalion in Touro Infirmary, New Orleans, were held, June 24, in honor of Dr. Rudolph Matas, who until his retirement in 1935 since 1895 had been affiliated with the institution. A bronze plaque carrying his likeness, executed by Mrs. J. Higginson Manning, New Orleans, was unveiled by Dr. Isidore Cohn, who succeeded him in 1935 as chief surgeon of the infirmary.

## SCIENTIFIC NOTES AND NEWS

PRESIDENT ROOSEVELT has designated four members of a medical research committee to specialize on the defense program. The appointees are: Dr. A. R. Dochez, professor of medicine at the College of Physicians and Surgeons, Columbia University; Dr. A. Baird Hastings, Hamilton Kuhn professor of biochemistry at Harvard University; Dr. Alfred N. Richards, professor of pharmacology at the University of Pennsylvania, and Dr. Lewis Hill Weed, professor of anatomy and director of the School of Medicine of the Johns Hopkins University.

THE Trudeau Medal of the National Tuberculosis Association has been awarded to Dr. John Alexander, professor of surgery at the Medical School of the University of Michigan and surgeon in charge of the division of thoracic surgery of the university hospital.

THE Adams Prize of the University of Cambridge has been awarded to Dr. H. Davenport, lecturer in mathematics in the University of Manchester.

DR. J. ENRIQUE ZANETTI, professor of chemistry at Columbia University, has reported for active duty in Washington as colonel in the Chemical Warfare Service.

DR. WILLIAM CHURCH OSBORN, a trustee of the Metropolitan Museum of Art, New York City, since 1904, has been elected president of the museum to succeed George Blumenthal, who died on June 27.

DR. G. WALTER STEWART, professor and head of the department of physics at the State University of Iowa, was advanced on June 20 from the vice-presidency to the presidency of the American Physical Society at its meeting at Providence, R. I. Dr. George B. Pegram, of Columbia University, who had been president since the first of the year, resigned on account of other duties. Dr. P. W. Bridgman, professor of physics at Harvard University, was elected vice-president. Dr. Pegram continues as treasurer of the society.

NEWLY elected officers of the American Society of Plant Physiologists for the year 1941-42 are: *President*, Professor E. C. Miller, of Kansas State College; *Vice-president*, Dr. W. E. Loomis, of Iowa State College; *Secretary-treasurer*, Dr. P. J. Kramer, of Duke University; *Member of the Executive Committee*, Professor W. F. Loehwing, of the State University of Iowa; *Member of the Editorial Board*, Professor O. F. Curtis, of Cornell University.

At the last meeting of the Sigma Xi Club of the Colorado State College the following officers were elected for the coming year: *President*, Dr. Lloyd E. Washburn, department of animal husbandry; *Vice-*

*president*, Dr. Ruth Sumner, department of physiology; *Secretary-treasurer*, Professor Wesley E. Pyke, High Altitude Laboratory.

DR. BYRON L. ROBINSON, professor of anatomy in the School of Medicine of the University of Arkansas, has been appointed dean of the school. He succeeds Dr. Stuart B. Cromer.

DR. RALPH I. DORFMAN, research assistant with rank of assistant professor in the laboratory of physiological chemistry at Yale University, has been appointed assistant professor of biochemistry in the School of Medicine of Western Reserve University. Dr. Dorfman will be associated also with the Brush Foundation and with the Department of Medicine of Lakeside Hospital.

DR. C. CANBY BALDERSTON has been made dean of the Wharton School of Finance and Commerce of the University of Pennsylvania. Dr. Balderston, who has been professor of industry at the Wharton School since 1931, succeeds Dr. Alfred H. Williams, who resigned on July 1 to become president of the Federal Reserve Bank of Philadelphia.

DR. ALBERT B. NEWMAN, who has been acting dean of the School of Technology of the College of the City of New York, has been appointed dean of the school.

DR. GEORGE C. VAILLANT, associate curator of Mexican archeology at the American Museum of Natural History, New York City, has been appointed director of the university museum of the University of Pennsylvania. He will take office early in September, succeeding Horace H. F. Jayne, who recently resigned to become assistant director of the Metropolitan Museum of Art, New York.

DR. A. J. GROUT, since 1930 a member of the research staff of the Biological Laboratory at Cold Spring Harbor, has been appointed honorary curator of mosses at the New York Botanical Garden. He is now working on mosses for the *North American Flora* with Dr. William C. Steere, of the University of Michigan.

DONALD COLLIER, of the Washington State Teachers College, Pullman, has been appointed curator of South American ethnology and archeology at the Field Museum of Natural History. In September he will undertake an expedition to Ecuador under the joint sponsorship of the Andean Institute and the Field Museum.

DR. FLOYD M. FELDMAN, director of rural health, District Number 3, of the Minnesota State Department of Health, has been appointed health officer of

Rochester. He succeeds Dr. Thomas B. Magath, professor of pathology and parasitology at the University of Minnesota and consulting physician of the Mayo Clinic.

DR. JOHN R. MCGIBONY has been appointed director of health of the U. S. Indian Service. He takes the place of Dr. James G. Townsend, now director of industrial hygiene for the National Institute of Health, who has directed the health division of the service since 1933.

SIR ARTHUR SMITH WOODWARD and Professor Matthew J. Stewart have been elected trustees of the Hunterian Collection of the Royal College of Surgeons, London.

It is reported in *Nature* that Sir Henry Tizard, rector of the Imperial College of Science and Technology, has been appointed an additional member of the Air Council of Great Britain. In this capacity, and as a member of the Aircraft Supply Council, he will have special responsibility for studying and advising on scientific and technical policy.

ACCORDING to the *News Edition* of the American Chemical Society additions to the staff of the Chemical Engineering Division of the Armour Research Foundation, Chicago, include Dr. Charles A. Coffey, formerly engaged in research for the meat packing industry, who will conduct investigations in oils and fats; Richard Belkengren, Rockefeller Foundation fellow at the University of Minnesota, assigned to further development of a process for rot prevention in shipment and storage of produce; Walter J. Armstrong, who has been engaged in graduate research at the State University of Iowa, to work on engineering process problems; Dr. Raymond G. Spencer and Carl C. Gamertsfelder to conduct x-ray diffraction and spectroscopic research, in the division of light and optics of the University of Minnesota. Dr. Spencer is on leave of absence from Albion College, where he is head of the department of physics.

DR. M. C. WHITAKER, vice-president of the American Cyanamid Company, is again chairman of the advisory committee for the eighteenth Exposition of Chemical Industries. The exposition will be held in the Grand Central Palace, New York, from December 1 to 6. Advance reservations already account for practically all the available exhibit space. Members of the committee include Dr. Raymond F. Bacon, chemical engineer of New York City; Dr. L. H. Baekeland, honorary professor of chemistry at Columbia University; Dr. W. S. Landis, of the American Cyanamid Company, president of the Chemists' Club; Raymond R. Ridgway, president of the Electrochemical Society; John V. N. Dorr, president of the

Dorr Company; Walter J. Murphy, editor, *Chemical Industries*; Dr. H. E. Howe, editor, *Industrial and Engineering Chemistry*; Dr. William L. Evans, president of the American Chemical Society; Dr. W. T. Read, dean of chemistry, Rutgers University; Charles F. Roth, manager of the exposition; H. J. Schnell, general manager, *Oil, Paint and Drug Reporter*; E. K. Stevens, associate manager of the exposition; W. D. Merrill, president, Salesmen's Association of American Chemical Industry; R. Gordon Walker, vice-president, Oliver United Filters, Inc., and Dr. E. R. Weidlein, director of the Mellon Institute.

THE National Advisory Cancer Council has recommended the following grants-in-aid: the University of California (Robert S. Stone and E. O. Lawrence), \$9,750 in aid of research on the effect of fast neutrons on human cancer; Memorial Hospital, New York City (C. P. Rhoads, George T. Pack), \$5,000 in aid of metabolic studies on patients with gastric cancer; the Society of the New York Hospital (George J. Heuer), \$5,000 for clinical researches in the early diagnosis of gastric cancer and the comparative value of clinical methods, with special reference to cancer control, and the University of Rochester (John J. Morton), \$5,000 for the study of the relation of diet and eating to human gastric cancer, to be carried out as part of a cooperative endeavor in several centers.

COLIN C. SANBORN, curator of mammals for the Field Museum of Natural History, sailed from New York on July 18 on a six months' expedition to southern Peru. The main part of his work will be concerned with research on native bats, in continuation of work begun in 1938 under a fellowship of the John Simon Guggenheim Foundation. The part of Mr. Sanborn's explorations sponsored directly by the Field Museum will be for the purpose of the continuation of the collection of specimens and data begun in 1939-40 when he went to Peru as a member of the Magellanic Expedition. At Arequipa he will be joined by an advanced student from a Peruvian university. Collecting will be carried on in southern Peru in localities ranging from sea level to an altitude of more than 15,000 feet on the plateau above Lake Titicaca. He will work also along the west coast, and in three river valleys in the eastern interior of the country, and returning, in the central and northern sections of Peru.

THE New York City Aquarium in the Battery will be closed on October 4. According to a statement made by Park Commissioner Moses, most of the fish will be moved to an aquarium to be built in the New York Zoological Park, the Bronx. It is questionable, however, whether they will be kept there or removed later to a new aquarium. The New York Zoological

Society, which administers the Aquarium at the Battery and the Bronx Zoological Park, is making a survey to determine the best site for a new aquarium.

THE third summer conference of the New England Association of Chemistry Teachers will be held at the University of Connecticut, Storrs, from August 12 to 15. A symposium is planned on the afternoon of each day on modern concepts of electrolytes. George B. Savage, Loomis School, Windsor, Conn., is chairman of the conference committee.

THE eleventh annual meeting of the American Malacological Union will be held at Thomaston and Rockland, Maine, from August 26 to 29.

THE second American Congress on General Semantics will be held on August 1 and 2 at the University of Denver.

THE summer meeting of the Pennsylvania Academy of Science will be held in Bedford, Pa., over the

week-end of August 8-9. Field trips to study the local natural history will be taken. For further information write to Dr. V. Earl Light, Lebanon Valley College, Annville, Pa.

THE Society of American Bacteriologists, the American Association of Immunologists and the American Society for Experimental Pathology would like to receive nominations for the Eli Lilly and Company Research Award in Bacteriology and Immunology. This award is to be made to the young man or woman working in a college or university, who in the opinion of the Award Committee, has done "the most outstanding work in the field of bacteriology or immunology." To be eligible for the award, the individual must not have passed his or her thirty-fifth birthday on April 30, 1941. Information concerning the award may be secured from I. L. Baldwin, University of Wisconsin, Madison. Nominations must be in his hands before September 15.

## DISCUSSION

### INDUCED BIOTIN DEFICIENCY AS A POSSIBLE EXPLANATION OF OBSERVED SPONTANEOUS RECESSIONS IN MALIGNANCY

MORE than 300 authenticated cases of spontaneous recession of malignant tumors in man have been reported in the literature by a number of authorities between 1890 and 1917. Rohdenburg, who compiled a comprehensive summary of these cases,<sup>1</sup> records that about a hundred of these recessions have been observed to take place "subsequent to, or during, an acute infection." Recessions had been observed to occur after smallpox, pneumonia, malaria and acute tuberculosis. However, "the greater number of cases in this group," Rohdenburg found, "have occurred after an attack of erysipelas, an observation which led to the use of toxins of the causative organisms as a therapeutic measure" (Coley's Fluid).

Recently, West and Woglom, in studies on the biotin content of tumors and other tissues,<sup>2</sup> found it "significant that in every case studied the biotin level of the tumor deviated sharply from the normal adult values in the same direction as that of the corresponding embryo tissues." For example, they found a four-fold increase in the biotin content of the embryo lung as compared with the normal adult lung of the rat, while the biotin content of cancerous tissues from the human lung was found to be about three times the biotin content of the normal tissues of the human

adult lung. "Other tumors of epithelial origin, obtained from human sources," they reported, "have also been found directly richer in the growth substance (i.e., biotin) than adjacent normal tissues."

It is by now well established that biotin, found last year to be identical with coenzyme R and vitamin H, the anti-egg-white-injury factor,<sup>3</sup> is essential for the vital functions of many organisms<sup>4, 5, 6, 7, 8</sup> and higher animals.<sup>9, 10</sup> No form of bacteria has so far been found that does not require it, though some have been found to possess the ability to synthesize it from available materials. Eakin, McKinley and Williams have shown that the tissues of chicks on a diet causing egg-white injury were deficient in biotin despite the abundance of this vitamin in the diet.<sup>11</sup> Later, Eakin, Snell and Williams<sup>12</sup> presented experimental evidence to show that commercial or fresh egg white is capable of inactivating biotin *in vitro*, "owing probably to the

<sup>3</sup> P. György, D. B. Melville, D. Burk and V. du Vigneaud, *SCIENCE*, 91: 243, 1940; V. du Vigneaud *et al.*, *SCIENCE*, 92: 62, 1940; P. György *et al.*, *SCIENCE*, 92: 609, 1940.

<sup>4</sup> F. Kögl and B. Tönnis, *Zs. phys. Chem.*, 242: 43, 1936.

<sup>5</sup> P. M. West and P. W. Wilson, *Enzymologia*, 8: 152, 1940.

<sup>6</sup> R. Nilsson *et al.*, *Ann. Landw. Hochschule Schwedens*, 7: 301, 1939.

<sup>7</sup> E. E. Snell and R. J. Williams, *Jour. Am. Chem. Soc.*, 61: 3594, 1939.

<sup>8</sup> J. R. Porter and M. J. Pelczar, *Jour. Bact.*, 41: 173, 1941.

<sup>9</sup> P. György, *Jour. Biol. Chem.*, 131: 733, 1939.

<sup>10</sup> P. György *et al.*, *SCIENCE*, 91: 243, 1940.

<sup>11</sup> R. E. Eakin, W. A. McKinley and R. J. Williams, *SCIENCE*, 92: 224, 1940.

<sup>12</sup> R. E. Eakin, E. E. Snell and R. J. Williams, *Jour. Biol. Chem.*, 136: 801, 1940.

<sup>1</sup> G. L. Rohdenburg, *Jour. Cancer Research*, 3: 193, 1918.

<sup>2</sup> P. M. West and W. H. Woglom, *SCIENCE*, 93: 525, 1941.

formation of a fairly stable compound of biotin with a special constituent of egg white." György *et al.*<sup>13</sup> later reported the isolation of a special constituent from raw egg white, called by them "avidalbumin" (recently changed to "avidin"), which showed itself more potent than egg white in producing egg-white injury, and also in biotin-binding capacity *in vitro*, thus establishing avidin as the special egg-white-injury constituent in raw egg white. This led them to assume that egg-white injury is a biotin-deficiency, brought about by "the unavailability of biotin because of its fixation to the avidalbumin" (avidin).

These developments, taken as a whole, lead to certain logical assumptions which, if proved to be correct in future experimental and clinical tests, would provide at least one explanation for the hitherto unexplained phenomenon of the spontaneous recessions in malignancy. For this reason the writer feels justified in offering the following as working hypotheses:

(1) Both the malignant cells and the micro-organisms associated with the observed cases of spontaneous recession require excess biotin for their metabolic activities. Two lines of evidence mentioned earlier would seem to support this hypothesis.

(2) If this hypothesis is proved correct, and it should not be too difficult to check, then the spontaneous recessions could be explained as the direct result of biotin-deficiency brought about by the avidin-like action of the micro-organisms, and particularly the streptococcus erysipelas, depriving the malignant cells of a factor vital for their continued existence.

(3) The dermatitis in erysipelas may in itself be a human form of egg-white injury, *i.e.*, unavailability of biotin brought about by the avidin-like action of the erysipelococcus.

(4) Raw egg white, or avidin, because of their ability to deprive pathogenic bacteria and malignant cells of a life-essential factor, suggest themselves as new therapeutic agents in conditions due to the presence of these entities. The resultant biotin deficiency could be controlled at any desired stage by the administration of definite amounts of biotin.

Butter-yellow rat liver tumors are relatively low in biotin<sup>2</sup> but this fits well into the general picture, as West and Woglom found the biotin content of the heart, liver and kidney of embryos to be appreciably lower than that of the normal adult heart, liver and kidney. Since the liver is known to act as the storage depot for vitamins of the B complex, the low biotin content of the butter-yellow rat liver tumors may be taken as an indication that tumor tissues of the liver do not possess the function of storage. If that is so, and this assumption seems logical in the absence of

any evidence to the contrary, then the relatively low biotin content of the butter-yellow liver tumors, not necessarily low in absolute values, may be explained on the grounds that the tumors have used up the stored biotin, thus giving added support to hypothesis I.

While it is probable that some, if not most, of these suggestions are now under consideration, or are being tested, by others, they are hereby presented in the hope that they may prove useful in crystallizing an idea.

WILLIAM L. LAURENCE

### PRE-EUCLIDEAN GREEK MATHEMATICS

IN a recent number of the well-known German periodical entitled *Mathematische Annalen*, dated January 14, 1941, it is announced that the "Jablonowskischen Gesellschaft der Wissenschaften" is offering a prize of R. M. 500 for an investigation which will increase our knowledge of the older Greek arithmetic and algebra, especially of the arithmetic of the Pythagoreans, of which it is stated here very little has been transmitted to us. The hope is expressed in this announcement that the recent discoveries with respect to the mathematics of the ancient Babylonians and the writings of the ancient Greeks relating to music may unitedly be able to throw new light on Greek arithmetic. Competing mss. for this prize are to be written either in German or in Latin and will be received by the said association up to the end of the year 1942.

A significant feature of this announcement is that it emphasizes the wide-spread and growing recognition of the fact that our present knowledge of the ancient Greek mathematics is still very imperfect, notwithstanding the enormous extent of the writings on this subject in recent years. Some years ago it was commonly regarded as sufficient to collect and quote Greek authorities, but in view of the fact that many of these are contradictory and were written long after the supposed discoveries to which they relate were made much less credence is now commonly given to these quotations than formerly. At least they are no longer regarded as final. The much more difficult method of examining critically the authenticity of various statements has been widely adopted, and this has naturally greatly increased the labors of the mathematical historians. This has been true, in particular, as regards many of the discoveries which have been commonly credited to Pythagoras, including the famous theorem known by his name but which was used by the Babylonians many centuries before Pythagoras was born.

The fact that the competing mss. for this prize are to be written either in German or in Latin is somewhat striking, but it can readily be understood when it is

<sup>13</sup> P. György *et al.*, *SCIENCE*, 93: 477, 1941.

remembered that in 1936 a mathematical periodical was started in Germany under the title *Deutsche Mathematik*, which has since then been widely supported by German mathematical writers even if the contents exhibit the fact that mathematics is an international subject which contains many evidences of the cooperation of writers of many lands. In recent years the German contributions have been extensive, but they were largely based on the earlier contributions of writers in other lands including the Greeks whose achievements the noted prize may help to clarify and to whom the entire mathematical world has often acknowledged itself indebted notwithstanding the growing credit to earlier civilizations.

This prize and the recently reported appointment of a professor of the history of mathematics in the University of Berlin seem to imply that this history is now receiving relatively much attention in Germany, notwithstanding the fact that the present disrupted condition in scientific work makes the unbiased study of this subject very difficult. The articles in the periodical noted in the preceding paragraph also indicate an emphasis on the history in recent German mathematical writings. In so far as these efforts are directed towards learning the actual situations they naturally receive the approval of all and should be especially appreciated in America in view of the relatively small amount of such work in our rapidly expanding mathematical activities of recent years. According to Felix Klein the thinking through of old problems by new methods is the source of pure mathematics.

G. A. MILLER

UNIVERSITY OF ILLINOIS

## CROSS-FERTILIZATION OF ECHINODERMS

It has long been known that the sea urchins *Strongylocentrotus purpuratus* and *S. franciscanus*, will cross-fertilize, reciprocally, but every investigator has noted that the percentage of cross-fertilizations is extremely variable. During a recent stay at the Hopkins Marine Station at Pacific Grove, Calif., it was found that the variability was largely due to the method of preparing the eggs for experimental use. The usual procedure of preparing sea urchin eggs is as follows:

The ovaries are removed from the cut animal and placed in a fairly large quantity of sea water; this is filtered through cheese-cloth to remove the debris from the exuded eggs; some investigators advocate several washings of the eggs with fresh sea-water; then a small quantity of the eggs are pipetted off into a Syracuse watch glass containing fresh sea water, and the sperm added. Using eggs prepared in this manner, it was found that when crossed with the sperm of the other species, very few eggs were fertilized, though 100 per cent. fertilizations occurred with the sperm of its own

species. If, however, the eggs were taken directly from the ovary of the cut animal and left crowded together in sea water in a Syracuse watch glass and immediately fertilized with the sperm of the other species, quantities of the eggs were fertilized. In the cross, *Strongylocentrotus purpuratus* ♀ × *S. franciscanus* ♂, the percentage, in one experiment, was 1 per cent. fertilizations with eggs prepared in the usual way (well washed and separated), and 80 per cent. with eggs direct from the ovary and crowded. The same batch of eggs, and sperm from the same male, were used in the experiment, and the counts were made of the blastulae just before swimming. The experiment was repeated with many different batches of eggs with the same general result; the reciprocal cross gave similar results, but the difference was not so great. In all cases, a large quantity of sperm was used, as it has long been known that over-insemination increases cross-fertilizations.

When the eggs of the sea urchin, *Strongylocentrotus purpuratus*, were crossed with the sperm of an entirely different genus, *Dendraster excentricus*, a sand-dollar, not a single fertilization was observed when the eggs were prepared in the usual way. But when the eggs from the same female were taken directly from the ovary and left crowded together and crossed with the sperm from the same *Dendraster* male, 10 per cent. of the eggs were fertilized.

Loeb has shown that increased alkalinity of the sea water favors cross-fertilizations. In the present case, we should expect an increased acidity due to the accumulation of CO<sub>2</sub> around the unwashed eggs. However, bubbling CO<sub>2</sub> through the sea water did not increase the percentage of cross-fertilizations; possibly the optimum CO<sub>2</sub> tension was not attained. Keeping the eggs for several hours slightly increased the percentage of cross-fertilizations. Sea water in which unfertilized eggs had been kept for 4 to 24 hours (at about 8° C. for the longer periods) gave a slightly higher percentage of cross-fertilizations for fresh eggs than did fresh sea water. It would certainly seem that some substance diffuses from the eggs which favors cross fertilizations and that this is present in effective quantity when the eggs are unwashed and crowded.

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## PHOSPHORESCENCE OF HUMAN TEETH

THE fluorescence of teeth is usually intense white with an occasional yellowish or greenish tinge. In older persons the fluorescence shifts into the longer wave-lengths, becoming reddish. Reddish fluorescence is also noted in the teeth of diseased persons.<sup>1</sup> A. H.

<sup>1</sup> J. A. Badley and J. Grant, "Fluorescence Analysis in Ultra-Violet Light." New York: D. van Nostrand Company, Inc., 1939.

van den Bergh and Hyman<sup>2</sup> attribute the red fluorescence of teeth to the presence of a porphyrin, and Tiede and Chromae<sup>3</sup> ascribe red fluorescence in teeth to the presence of proteins, since they were able to duplicate the luminescence of natural teeth by heating apatite preparations with proteins.

Radley and Grant,<sup>1</sup> in their discussion of the fluorescence properties of human teeth do not mention the existence of phosphorescence. To the knowledge of the writer phosphorescence in living human teeth has not been previously noted.

In an apparently healthy twenty-year-old male medium green phosphorescence of several seconds duration was excited in both upper and lower teeth by

short wave-length filtered (CG 986) ultraviolet radiation from a cold mercury-quartz lamp. Ultraviolet radiation of longer wave-lengths, *e.g.*, 3600 A.U., failed to excite this phenomenon in the same teeth. Green phosphorescence was also noted in the teeth of older persons.

It would be interesting to study the phosphorescence of teeth in relation to disease, deficiency of diet, poisoning and other conditions, since the action might provide a simple diagnostic measure for certain pathological states.

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## SCIENTIFIC BOOKS

### RECENT PUBLICATIONS OF THE BRITISH MUSEUM (NATURAL HISTORY)

SINCE the review of British Museum publications in *SCIENCE*, December 6, 1940, the following have come to hand:

*John Smart. Instructions for Collectors, No. 4A. Insects. 1940. 164 pp.* A very useful little illustrated manual, giving an account of the various groups of insects and the methods of collecting and preserving them. It is just the sort of book which will be useful to a beginner or amateur and it must be emphasized that those who make no pretense to profound scientific knowledge may nevertheless do very important work as collectors, if they will learn how to do the work and follow advice as to what to collect. It would have been a good thing if the author, in his introductory remarks, had cited some of the results of the work of amateur collectors, as he could so easily have done from his experience at the museum. In the chapter on "Collecting Apparatus and Methods," I am surprised to find no mention of gelatin capsules, so useful when collecting small insects in the field. One's first reaction, on receiving such a book in the midst of a tragic war, is to wonder why it should be issued at this time. Aside from the feeling that normal scientific work should be continued even in wartime as far as circumstances permit, along with other activities which help to keep us sane and hopeful, there are special reasons for promoting entomology under the present circumstances. During the last war important collections and studies were made in various countries, and the work on mosquitoes and lice, in particular, proved important in relation to the health of the armies. At the present time, men are stationed at various localities in Africa

and Asia, where the insects are imperfectly known. Much time is spent in guarding rather than fighting, and it is a good thing to cultivate amateur scientific interests to prevent boredom and add to the joy of life. In Britain, also, there are groups of men all over the country, whose duty it is to watch and wait, always ready to meet any emergency that may arise, but most of the time with nothing particular to do. We have been much concerned to furnish reading matter for these groups, but in addition, amateur scientific interests are very helpful, and it is easy and inexpensive to collect insects. Among the smaller insects, many discoveries or original observations may be made even in Britain. There is still another service which entomology may render. Many persons who have been injured leave the hospitals partly cured, and there is a period, sometimes a long period, before they can resume their normal occupations. For such people arrangements have been made for instruction in the manual arts, such as bookbinding, but equally valuable is the development of a scientific hobby, which may be continued through life. Having all these matters in mind, we no longer feel that Dr. Smart's guide is superfluous, even in wartime.

*Ruwensori Expedition. Vol. II, No. 4—Coenosiinae, by F. D. Van Emden; No. 5. Empididae, by C. Garrett Jones.* These two papers on African flies are of interest to specialists, but they also serve to emphasize what has been said above concerning collectors. In a series of Empididae collected, it was found that the great majority (39 species) consisted of previously unknown species. Only three, in fact, had previously been described. Most of the material was collected by Dr. F. W. Edwards, the master student of Diptera, whose recent death we so greatly deplore.

*Great Barrier Reef Expedition. The Biology of Reef-Building Corals. By C. M. Yonge, July, 1940.*

<sup>2</sup> A. H. van den Bergh and Hyman, *Koninkl. Akad. Wetensch. Amsterdam wisk. natk. Afd.*, 36: 1096, 1927.

<sup>3</sup> E. Tiede and H. Chromae, *Ber.*, 67B: 1988, 1934.

A very interesting, beautifully illustrated report, discussing the characteristics of coral reefs, nutrition, adaptations of reef-building corals, significances of the Zooxanthellae, effect of light on coral growth, reproduction and development, growth of corals, maintenance of reefs, form of coral reefs, distribution of reef-building corals and evolution of reef-building corals. To this is added an account of the appearance of living coral polyps, by Professor T. A. Stephenson.

This is the sort of book which should be in every university department of zoology. I have been especially struck by an observation, quoted from Hedley, concerning the effects of excessive rainfall on coral reefs in certain localities. It appears that between January 22 and 29, 1918, a total of 35.7 inches of rain fell at Bowen, Queensland, and this coincided with the full moon spring tides. A thick layer of fresh water floated far out on the surface of the sea. When the low tide fell, this surface water sank till the whole reef was immersed in it. Then every living thing that dwelt there—corals, worms, shell-fish and crabs—died immediately. Putrefaction from these enlarged the zone of destruction. This slaughter reached as deep as 10 feet below mean tide level. Crossland describes a similar devastation of corals at Tahiti during exceptional rainfall in January, 1926.

During the past spring, Santa Barbara and adjacent regions were visited by excessive rains, which from the nature of the slopes must have resulted in a great deal of fresh water pouring into the sea. There are no coral reefs, but we may wonder what may have been the effect on the plankton and on the animals of the littoral zone.

*John Murray Expedition.* Vol. II. No. 5. Chemical and Physical Investigations, by A. F. Mohamed, of the University of Cairo. The pH observations made in the waters of all oceans and seas until 1934 are reviewed, and the detailed observations made in the northwestern Indian Ocean are recorded, with a dis-

cussion of the effects of the hydrogen-ion concentration on the life in the sea.

Vol. VI, No. 8. Ostracoda, by H. Graham Cannon. An account of the comparatively few Ostracoda obtained, one of the species being new.

*The Francis Walker types of Trichoptera in The British Museum.* By Cornelius Betten (Cornell University) and Martin E. Mosely (British Museum). June, 1940. 248 pp. With a portrait of Walker and many illustrations in the text.

Francis Walker was responsible for sixty-eight little volumes published by the British Museum between 1844 and 1873. It is estimated that some 50,000 species of insects were catalogued as being in the collections of the museum, and very many were described as new. It will be readily understood that this work had to be done in a more or less superficial manner to cover so much ground, and later generations have condemned Walker because they could not make out his species from the brief descriptions. In the preface to the present volume it is stated that Walker's catalogues "are an example of the un wisdom of allowing the curatorial needs of museum work to outweigh its scientific standards." Yet it is only fair to recognize that nearly a hundred years ago taxonomic methods were poorly developed in comparison with those of to-day, and even in quite modern times very many species (especially of Lepidoptera) have been described in a manner which would hardly permit their recognition without specimens or illustrations. As the Walker types are nearly all in the British Museum, they are available for study, and the present volume gives a critical account of Walker's species of caddisflies. The treatment is full and exact; of Walker's 101 specific names, 78 are retained, two are found to be preoccupied, and 21 are synonyms. Most of the species are from North America, and the book will be invaluable to all students of American Trichoptera.

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## SOCIETIES AND MEETINGS

### THE SEVENTH ANNUAL WASHINGTON CONFERENCE OF THEORETICAL PHYSICS, MAY 22-24, 1941

#### TOPIC

THE topic of the Seventh Washington Conference of Theoretical Physics, May 22 to 24, 1941, was the theory of elementary particles. The elementary particles known at the present time are: The light-quantum; the electron; the proton; the neutron; the positron; the neutrino; and the meson. The rapid development of this field is illustrated by the fact that the last four of these particles were unknown before the

last decade. The main subdivisions of the topics discussed at the conference were (1) elementary particles in cosmic rays, (2) elementary particles in nuclei and (3) field theory.

#### PARTICIPANTS

Sixteen physicists representing eleven universities were invited to act as conveners of the conference. Besides these, eighteen guest-physicists took part, representing twelve universities, government departments and private research organizations. In order to keep the group small enough to make possible

efficient discussion the effort was made to limit attendance, other than the invited conveners, to those whose work is in intimate relation to the topic of the conference.

#### SCHEDULE

There were three general meetings on the afternoons of May 22 and 24 at the Administration Building of the Carnegie Institution of Washington and on the afternoon of May 23 at the George Washington University. Dr. Fermi at George Washington University gave a lecture at 8 p.m., May 23, on the elementary particles; those participating in the conference, the members of the Washington Colloquium and the general public were invited. During the mornings of May 23 and 24 there were informal discussions in which smaller groups of the conference took part.

#### SUMMARY OF DISCUSSIONS

The discussion on the afternoon of May 22 was led by Dr. Oppenheimer. The main topic was the theory of the meson. The meson is a particle discovered in the cosmic rays. The meson has a charge which is equal to the charge of the electron and its mass is intermediate between the masses of the electron and the proton. The meson is not present in the cosmic radiation when it arrives at the earth's atmosphere but is created by some collision between the original cosmic-ray particles and constituents of the atmosphere. The meson is not stable but can disintegrate into some other particles whose nature is not yet established definitely. The existence of the meson and its important rôle in the structure of the atomic nucleus have been suspected even before the discovery of this particle in cosmic rays. The main problems discussed concerning the meson were the magnitude of its spin or angular momentum and the value of its magnetic moment. The evidence from the behavior of mesons in cosmic rays makes it highly probable that the value of the angular momentum is zero or one half in the quantum units of angular moments. The magnetic moment is zero if the angular momentum is zero, and there is reason to believe that the magnetic moment is in accordance with Dirac's theory of spinning particles if the angular momentum is one half. It was suggested that the meson may have the angular momentum but that a change in sign would be connected with the reflections of a meson-wave function in space. This means mathematically that the meson is represented by a pseudo scalar rather than a scalar. This assumption has important bearing on the meson-theory of nuclear forces and on the theory of beta-decay.

A further point in this discussion concerned the number of mesons obtainable in a single collision suf-

fered by a cosmic-ray particle. It has been suspected for some time that mesons are created in large batches or showers. At the conference it was suggested that mesons and nuclear particles interact strongly and that this strong interaction may account for the great number of mesons created simultaneously. The interesting part of this explanation is that in spite of the strong interaction there does not result a particularly strong scattering of the mesons by the nuclear particles.

On the second afternoon Dr. Wigner was the leader of the discussion. The discussion centered around the structure of more complex nuclei. These nuclei can absorb electromagnetic waves just as atoms do, but while atoms absorb ordinary or ultraviolet light the radiation absorbed by nuclei is of much shorter wavelength and is called gamma-radiation. The question of most interest about this gamma-radiation arises from its unexpectedly small interaction with nuclei. The interaction is much smaller than one would expect from the rough picture of an oscillating elementary charge which is confined in its motion to the small dimensions ( $10^{-12}$  cm) of a nucleus. The possibility was discussed that this simple "dipole" interaction must be replaced by a "quadrupole" interaction arising from the oscillation of several charges whose main effects cancel each other. A second question discussed at the same time was concerned with the decay possibility of the beta-active substances. Nuclei showing beta-activity emit either an electron or a positron and in addition a neutrino. The neutron is a particle whose existence has been postulated to avoid contradictions with the law of energy conservation and other conservation laws. The decay probabilities in the beta-activity depend on the assumptions about angular momenta and other properties that the two ejected particles possess at the moment when leaving the nucleus. It has been attempted to draw some conclusions about these properties from the empirical facts of the beta-decay.

The attempt was also made to find systematic relations between the composition of the nuclei and their beta-decay. The beta-decays in the series  $\text{He}^6$ ,  $\text{B}^{10}$ ,  $\text{C}^{10}$ ,  $\text{C}^{14}$  proved to be particularly difficult to understand. These nuclei consist of an even number of neutrons and an even number of protons. The number of neutron-pairs differs from the number of proton-pairs by +1 or -1. In spite of this similarity in structure the beta-decay periods differ so strongly that it seems necessary to assign the  $\text{He}^6$  and  $\text{C}^{10}$  decays to allowed transitions while assuming that the decays of  $\text{B}^{10}$  and  $\text{C}^{14}$  are strongly forbidden.

The discussion of the third afternoon session was led by Dr. Weisskopf. The main problem was the nature of the forces represented by various fields

which have been used both in classical physics and in modern theory. If, as it is assumed at present, nuclear forces are due to emission and absorption of mesons by nuclear particles then it is probable that within the nucleus the classical concept of a field of forces must be abandoned. But it was brought out at the conference that even one of the oldest field theories—the theory of electromagnetic fields—is open to serious revision when investigated in small regions of space, particularly when applied in the immediate neighborhood of elementary particles. One of the most radical suggestions that was put forward would abandon completely the concept of a field and would reintroduce instead the idea of interaction of particles at a distance.

The question of artificial-meson production was discussed and here there seems to be some hope of practical results as soon as it becomes possible to bombard nuclei with protons of about 100 million volts. It was found that even at such high bombardment-energies the influence of binding-energies within the nucleus remains important. Artificial production of mesons would probably help very greatly in understanding the nature of elementary particles and of nuclear forces.

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## SPECIAL ARTICLES

### ON THE HORMONAL ACTIVITY OF A STEROID COMPOUND

EXPERIMENTS on immature adrenalectomized rats have shown that  $\Delta^5$ -3-hydroxy-21-acetoxy-pregnene-20-one or acetoxy-pregnenolone (A.O.P.), an intermediary product in the Steiger and Reichstein<sup>1</sup> synthesis of desoxycorticosterone acetate (D.C.A.), possesses pronounced corticoid<sup>2</sup> activity. This finding was deemed worth recording, since up to the present no artificial steroid has been shown to possess corticoid potency and A.O.P.—though simpler to manufacture than D.C.A.—has not been assayed for any possible biological activity.

TABLE I  
ACTION OF A.O.P. ON ADRENALECTOMIZED RAT\*

Treat- ment	Hemo- globin in g/100 ml of blood	Glucose in mg/100 ml of blood	NaCl in mg/100 ml of blood	N.P.N. in mg/100 ml of blood	Deaths
Oil	14.1	68	410	142	4
A.O.P.	9.0	108	471	82	0
	P=0.02	P=0.02	P<0.01	P<0.01	

\* All figures in the table represent averages of each group. The significance of the apparent differences between treated and untreated animals was evaluated by "Student's" method for small samples and is expressed in terms of probability estimated by graphic interpolation in Fisher's table of  $t^2$ . It is generally agreed that differences may be regarded as significant if  $P$  is smaller than 0.05.

In our first experiment 5 male and 5 female immature albino rats (weighing 35 to 46 g) were treated once daily subcutaneously with 2 mg of A.O.P. in 0.1

<sup>1</sup> M. Steiger and T. Reichstein, *Helvet. chim. Acta*, 20: 1164, 1937.

<sup>2</sup> The term "corticoid" is used here instead of the cumbersome designation "adrenal cortical hormone-like" in accordance with the recently proposed terminology of the steroid hormone actions (H. Selye, *Nature*, in press).

ml of peanut oil on 4 consecutive days, their adrenals having been removed on the first day of treatment. They were killed 6 hours after the last injection simultaneously with 5 male and 5 female adrenalectomized controls (weighing 34 to 47 g) treated with 0.1 ml of peanut oil only. The results summarized in Table I clearly indicate that this treatment was beneficial as judged by its ability to maintain life, to prevent the hemoconcentration (detectable by the rise in blood hemoglobin determined with Evelyn's photoelectric colorimeter), the decrease in blood chlorides (expressed as NaCl determined by Van Slyke's method), the hypoglycemia (Schaffer-Hartmann-Somogyi method), and the rise in blood N.P.N. (Folin and Wu method modified for microdetermination with the Evelyn photoelectric colorimeter).

In order to gain quantitative data concerning the corticoid potency of A.O.P. the compound has been assayed in doses ranging down to 120 gamma per day given in two subcutaneous injections to adrenalectomized rats weighing 38 g on the average. It was found to be only slightly less active than D.C.A. as judged by the ability of this dose of the two compounds to maintain life and permit growth in the absence of the suprarenals. The only apparent qualitative difference between the action of the two steroids appears to be that, unlike D.C.A., A.O.P. caused no adrenal cortical atrophy in intact female rats weighing 100 g and receiving 15 mg of the compound subcutaneously on 20 subsequent days.

Similar experiments revealed that  $\Delta^5$ -3-hydroxy-pregnene-20-one likewise possesses corticoid activity.

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\* R. A. Fisher, "Statistical Methods for Research Workers," 6th Edition, Edinburgh, 1936, p. 138.

## THE HUMAN EXCRETION OF CAROTEN- OIDS AND VITAMIN A<sup>1</sup>

We have examined the intestinal excretion of vitamin A, carotene and xanthophyll in human subjects, in order to provide an objective measure of the dietary content of these substances, and to determine upper limits for their intestinal absorption.

Weighed samples of fresh feces were ground with equal weights of anhydrous sodium sulfate, and the powdery mixture was Soxhletted with *n*-pentane. The extract was saponified under nitrogen in 6 per cent. KOH in methanol. The non-saponifiable fraction was partitioned between benzene and 90–95 per cent. methanol, to separate epiphasic “carotenes” from hypophasic “xanthophylls.” Both fractions recombined, or portions of the original extract, were brought into chloroform for the antimony chloride reaction with vitamin A. All concentrations were measured with the Pulfrich Photometer by methods previously described.<sup>2</sup> The average recovery of added carotene or xanthophyll was 80 per cent., of added vitamin A 74 per cent. The qualitative efficiency of the extraction and fractionation procedures was checked spectrophotometrically.

A number of earlier investigations of carotenoid excretion have underestimated the time required for these substances to pass through the intestine.<sup>3</sup> The excretion of single large doses of carotene or xanthophyll in cottonseed oil ordinarily begins within 24 to 48 hours, rises to a maximum in the third to fifth days, and ceases in the fifth to seventh days or even later, depending upon the size of the dose. A single determination of feces carotenoid yields information, therefore, not on the vagaries of a single meal, but on the level of carotenoid ingestion over a considerable period. This factor stabilizes the measurements, and adds greatly to their general usefulness.

### EXCRETORY LEVELS

Single samples of feces from 20 subjects eating well-balanced unrestricted diets contained 13.5–328 (av. 122)  $\mu$ gm. of carotenes, and 4.72–47.2 (av. 26.0)  $\mu$ gm. of xanthophylls per gram fresh weight. One subject whose total carotenoid excretion on an unrestricted diet was followed for 30 days yielded very similar

results: 11.7–286 (av. 142)  $\mu$ gm. of carotenes and 8.9–105 (av. 29.0)  $\mu$ gm. of xanthophylls per gram of feces. The daily excretion of this subject averaged 74.5 grams; in 3 other subjects it averaged 53, 103 and 165 grams. The average water content varied between 71 and 75 per cent. The carotenoid concentration is relatively independent of the day-to-day bulk of the feces, even when this is increased by adding agar to the diet. It is curious that the carotene content of these “normal” feces is about equal to that of green leaves. The relative proportions of carotenes and xanthophylls, however, are the reverse of those in the leaf, apparently due to the preferential absorption of xanthophylls in the human intestine.

On passing from a high-carotenoid diet to one designed to contain the equivalent of about 100 I.U. of vitamin A daily, the feces carotenoid concentrations in 11 subjects dropped to 0.69–5.47 (av. 2.99)  $\mu$ gm. of carotenes and 0.79–3.73 (av. 2.00)  $\mu$ gm. of xanthophylls per gram. In two subjects whose diets were controlled more rigidly for long periods, the level of excretion fell still lower, to 1.22–1.70  $\mu$ gm. of carotenes and 0.94–1.18  $\mu$ gm. of xanthophylls per gram. The feces carotenoids provide, therefore, a sensitive index of the carotenoid levels of the diet.

Even at the lowest intake levels the feces carotenoids are virtually entirely of dietary origin. On passing from a high to a low-carotenoid diet, the rate of excretion falls to the new level within 5 to 7 days. When carmine is fed with the last high-carotenoid meal, the concentration of excreted carotenoid continues to fall no more than a day longer than carmine continues to appear in the feces. Furthermore, at the lowest excretory levels the daily excretion is still only about 70–80 per cent. of the daily intake, measured by direct extraction of 24-hour replicas of the diet. Only negligible amounts of feces carotenoids, therefore, can originate in intestinal organisms or by excretion from internal reserves through the intestinal wall.

### PROPORTIONS EXCRETED

The excretion of carotene in cottonseed oil (the leaf mixture containing about 90 per cent.  $\beta$ - and 10 per cent.  $\alpha$ -carotene) was determined in two subjects. Five experiments were performed, with ingestion periods ranging from a single dose to 10 days of regular feeding, and daily intake varying between 1.88 and 19.6 mgm. The fractions excreted in these experiments were 61.3, 80.8, 57.3, 69.7, and 49.3; average 59.7 per cent.

In similar experiments in which crystalline leaf xanthophyll in cottonseed oil was fed at the rate of 10.1 mgm. daily, the average excretory rate in one subject was 10.5  $\mu$ gm. per gram feces, and the total

<sup>1</sup> This research was supported in part by a grant to G. W. from the Josiah Macy, Jr. Foundation. Halibut liver oil and general dietary supplements were generously supplied by the Abbott Laboratories of North Chicago, and carotene by the S. M. A. Corporation of Chicago.

<sup>2</sup> G. Young and G. Wald, *Amer. Jour. Physiol.*, 131: 210, 1940.

<sup>3</sup> Cf. H. E. C. Wilson, S. M. Das Gupta and B. Ahmad, *Ind. Jour. Med. Res.*, 24: 807, 1937.

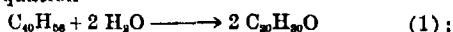
excretion during an ingestion period of 16 days was 8.3 per cent. of the intake.

When vitamin A in halibut liver oil was fed at a level of 23.7 mgm. per day (about 76,000 I.U.), the excretory rate in 6 subjects averaged 20.6  $\mu$ gm. (about 66 I.U.) per gram feces. The total excretion in two subjects during ingestion periods of 8 and 16 days was 3.97 and 2.74 per cent. of the intake. At still higher intake levels the excreted fraction rose sharply. Conversely, when the daily intake was reduced to about 25,000 I.U., the excretory rate in one subject fell to about 1/10 of its previous value, and a second subject excreted no measurable amount of vitamin A at all. In no case could we obtain a test for vitamin A from the feces of subjects on unrestricted, unsupplemented diets. It appears from these experiments that, unlike carotene or xanthophyll, vitamin A is not excreted until the intake reaches a threshold value, well above all ordinary dietary levels; and that above this the fraction excreted rises with the intake.

De has performed experiments similar to these in the rat.<sup>4</sup> He found the excretion of vitamin A in halibut liver oil to be 3 to 5 per cent. over a wide range of intake levels. The average excretion of carotene in oil was 42.5 per cent., or only about two thirds of that in our experiments on human subjects.

In bioassay experiments on rats, vitamin A is almost exactly twice as potent as an equal weight of  $\beta$ -carotene.<sup>5</sup> If one assumes that the fractions of vitamin A and carotene not excreted are absorbed—the excretion in any case sets an upper limit to the absorption—such apparent absorptions explain adequately the relative potencies of these substances in the rat.<sup>4</sup> By a parallel argument, due to its low apparent absorption, carotene in human bioassay should be at best only about 40 per cent. as effective as an equal weight of vitamin A; and should possess only about two thirds the potency now assigned to it on the basis of rat assays. Some confirmation of this conclusion has already appeared in human bioassay experiments.<sup>6</sup>

It is not now known whether  $\beta$ -carotene is converted to vitamin A *in vivo* by symmetrical cleavage, according to the equation



or by stepwise degradation to yield a single molecule of vitamin A. In the former instance carotene and vitamin A should be about equally potent *in vivo*; in the latter, carotene should be only about half as potent as the vitamin. The fact that in rats the different potencies of these substances are explained by their differential absorptions implies that *following absorp-*

*tion* they are about equally effective, and is strong presumptive evidence for the operation of equation (1). The present experiments indicate a similar possibility in man.

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### CORRELATION OF ACTIVITY PER UNIT WEIGHT OF TOBACCO-MOSAIC VIRUS WITH AGE OF LESION

It has been assumed by investigators working with plant viruses that each virus particle attains its full biological activity as soon as it is formed and that any increase in activity is due to an increase in the number of these infectious units. This would infer that all virus samples prepared under identical conditions should have the same activity per unit weight of virus regardless of the source of the sample. Examination of the literature reveals little experimental evidence in support of this assumption. What evidence there is has been derived from activity measurements of crude plant juice. Such measurements have given no information regarding the possible presence of infectious particles of different sizes and weights.

The development of the ultracentrifuge for virus isolation and purification, together with improvements in the local lesion method for measuring the activity of tobacco-mosaic virus, has made it possible to study virus samples containing known weights of virus protein. This technique has been applied to a study of the virus content and relative activity of preparations extracted at various intervals after inoculation. It was soon found<sup>1</sup> that under nitrogen-deficient conditions there was a falling off in activity per unit weight of virus. This finding led to a critical examination of the biological activity of virus in newly formed lesions.

Turkish tobacco plants (*Nicotiana tabacum* L.) were grown in nutrient sand cultures and supplied a complete nutrient solution. When about 6 inches tall, the plants were inoculated by rubbing over the entire upper surface of one mature leaf on each plant with a suspension of tobacco-mosaic virus (*Marmor tabaci* H.). At 5-day intervals, inoculated leaves from representative plants were harvested, frozen and then minced. The cold juice was cleared of insoluble materials by low-speed centrifugation and then ultracentrifuged. The sediment was suspended in phosphate buffer, cleared by low-speed centrifugation and again ultracentrifuged for 1 hour. Virus-protein content was calculated from the nitrogen content of the suspension of the sediment from the second ultra-

<sup>4</sup> N. K. De, *Ind. Jour. Med. Res.*, 24: 751, 1937.

<sup>5</sup> T. H. Mead, S. W. Underhill and K. H. Coward, *Biochem. Jour.*, 33: 589, 1939.

<sup>6</sup> L. E. Booher, E. C. Callison and E. M. Hewston, *Jour. Nutrition*, 17: 317, 1939.

<sup>1</sup> E. L. Spencer, *Plant Physiol.*, 16: 229, 1941.

centrifugation. The biological activity per unit weight of virus protein in this suspension was assayed on bean plants (*Phaseolus vulgaris* L. var. Early Golden Cluster) by the local lesion method, as modified by Spencer and Price.<sup>2</sup> The results were as follows: The content of virus protein in the inoculated leaf continued to increase for as long as 20 days after inoculation. This was a point of immediate interest, as it had been generally supposed that the virus reached its maximum concentration in the inoculated leaf within 7 to 10 days following inoculation. From the activity measurements, it was further found that the activity of the virus protein 5 days after inoculation was only about 25 per cent. of that of virus protein isolated 15 days later. Between the 5th and 10th days, the activity of this material almost doubled, and the increase continued until a maximum was reached about 20 days after inoculation. Therefore, not only the amount of virus protein but also the activity per unit weight of the material increased up to 20 days. This would indicate that virus in young lesions was lower in activity than that from somewhat older lesions. Subsequently, it was found that virus protein from the inoculated leaf was more active than that isolated at the same time from the top of the plant. This result might have been expected in view of the previous experiment, since it can be assumed that part of the virus lesions in the inoculated leaf were formed earlier than any of those in the top of the plant and therefore were somewhat older.

In regard to the characteristics of virus from young and old lesions, preliminary analyses with the ultracentrifuge have shown that a preparation from the old lesions had only one component. However, a sample of virus from young lesions prepared at the same time appeared to be made up of two components, one of which was about double the length of that of the other as determined by the sedimentation constant.

Experiments also indicate that nitrogen may be an important factor in increasing the activity per unit weight of virus *in vivo*. When nitrogen was withheld 10 days after inoculation, virus protein in the inoculated leaf continued to form at about the normal rate for a limited period, but the activity of this material, on a weight basis, remained fairly constant at the level reached about the time when nitrogen was last added. The activity at this point was about one half that ultimately displayed by virus protein from normal nitrogen-fed plants. Preliminary experiments have indicated that it may even be possible to increase this unit activity *in vitro* by supplying the virus with suitable forms of nitrogen.

The observations clearly show that virus in young lesions displays on a unit weight basis only a fraction of its potential biological activity and that such virus may vary somewhat in size and shape from virus isolated from older lesions.

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## SCIENTIFIC APPARATUS AND LABORATORY METHODS

### MEASUREMENT OF RESPIRATION AND GLYCOLYSIS OF A SINGLE SAMPLE OF TISSUE IN SERUM

WITH the development of a sensitive method of colorimetric analysis for lactic acid<sup>1</sup> and the "neutralized" serum technique for the manometric measurement of oxygen consumption of tissues suspended in serum,<sup>2</sup> it has become possible to determine in an ordinary Warburg vessel the rates of respiration and glycolysis<sup>3</sup> of a single sample of tissue suspended in serum. Respiration is determined manometrically and glycolysis chemically. At the beginning of the experimental period, a sample of approximately 0.2 cc of serum is tipped from the main vessel onto a few crys-

tals of sodium fluoride in the side-well. The fluoride prevents glycolysis in the few cells which may enter with the serum. The tissue slices are prevented from being tipped in by first inclining the vessel in the opposite direction, allowing the slices to settle and decanting the serum. At the end of the experimental period, a 0.1 cc sample of this serum is analyzed for the initial lactic acid concentration. The serum remaining in the side-well is returned and mixed with the contents of the main vessel and a 0.1 cc sample of this serum is analyzed for the final lactic acid concentration. The amount of lactic acid produced by the tissue during the experimental period is given by the formula

$$X_{Lac} = (C - C_0) (V_0 - V_1), \text{ where}$$

$X_{Lac}$  = mg. of lactic acid formed during experimental period.

$C$  = Lactic acid concentration in mg./cc. at end of experimental period.

$C_0$  = Lactic acid concentration in mg./cc. at beginning of experimental period.

$V_0$  = Volume of serum originally placed in vessel (usually 2 cc.).

$V_1$  = Volume of serum removed from side-well (usually 0.1 cc.).

<sup>2</sup> E. L. Spencer and W. C. Price, *Amer. Jour. Bot.*, 28: (in press), 1941.

<sup>1</sup> S. B. Barker and Wm. H. Summerson, *Jour. Biol. Chem.*, 138: 535, 1941.

<sup>3</sup> J. MacLeod and C. P. Rhoads, *Proc. Soc. Exper. Biol.*, 41: 268, 1939. A. Canzanelli and D. Rapport, *Amer. Jour. Physiol.*, 127: 296, 1939. C. O. Warren, *Amer. Jour. Physiol.*, 128: 455, 1940. D. G. Friend and A. B. Hastings, *Proc. Soc. Exper. Biol.*, 45: 137, 1940.

<sup>4</sup> Used in the restricted sense of meaning lactic acid formation.

During the experimental period, the oxygen consumption is determined manometrically in the usual way, with KOH in the center well to absorb  $\text{CO}_2$ . One advantage of this method over differential manometry for measuring tissue respiration in serum is that the time-course of respiration may be followed, and by using vessels equipped with more than one side-well, additional samples of serum may be withdrawn at intervals to follow the time-course of glycolysis.

Tests of the method show that the same figure for  $Q_{\text{O}_2}^0$  is obtained by this "side-well technique," where only the serum is analyzed, as by the usual method of analyzing separate samples at the beginning and end of the experiment and including the tissue in the analysis. In the case of bone marrow, the only tissue so far studied by these methods, the  $Q_{\text{O}_2}$  is the same in neutralized as in unaltered serum,<sup>4</sup> but the  $Q_{\text{O}_2}^0$  is higher in neutralized serum, apparently an effect of the absence of  $\text{CO}_2$ . This finding may not apply to other tissues.

These methods may of course be used with any medium, but they are particularly useful when it is important to use serum, to conserve tissue and to use as few manometers as possible. The chemical method of measuring glycolysis has the advantage of being virtually specific for lactic acid, and accuracy is gained by making the initial and final analyses on one sample of tissue rather than on separate samples, as in the usual way.

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### THE PRESERVATION OF OXIDIZABLE SUBSTANCES IN SOLUTION<sup>1</sup>

CERTAIN chemical and biological preparations, notably those used for growth stimulation or containing natural sulphhydryl complexes are prone to gradual oxidation and subsequent loss of potency when in solution. Shinohara<sup>2</sup> has given formulas for these inactivating oxidations and our own work Owen<sup>3</sup> on tissue extracts are in fair agreement with his findings.

After attempting to prevent oxidation in these solutions by refrigeration, tightly capping the vials and employing antioxidants with a minimum of success we found the following procedure to be effective. The embryonic extract or solutions are prepared in the usual manner either aseptically or with permissible amounts of preservative. These are then strained or

filtered as desired. The preparation is then placed in open beakers or wide-mouthed screw cap vials and set at room temperature into a vacuum desiccator. The pump is started and sufficient vacuum applied to cause mild bubbling of the solution but little or no loss in volume by evaporation. Usually not over five minutes pumping is required to remove the dissolved air. The vacuum is then replaced with an inert gas, as carbon dioxide, slowly let in. The containers are filled to the top and the cap screwed on and tightened before removal from the desiccator. Low melting paraffin may also be used to seal the containers. All air must be excluded to insure protection from oxidation.

As an example 1:100,000 cysteine hydrochloride solutions and tissue extracts containing free sulphhydryl were maintained at room temperature for over six months with no apparent loss of sulphhydryl. Similar solutions not so treated usually gave a negative sulphhydryl test after one to four weeks. The method of testing was that used by Owen<sup>3</sup> employing the phospho-18-tungstic acid reagent of Folin and Marenzi.<sup>4</sup>

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<sup>4</sup> O. Folin and A. D. Marenzi, *Jour. Biol. Chem.*, 83: 109-114, 1929.

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<sup>4</sup> C. O. Warren, *loc. cit.*

<sup>5</sup> This work was done during the tenure of a Lewis Cass Ledyard, Jr., Fellowship, New York Hospital, 1940-1941.

<sup>1</sup> Published with the permission of the Medical Director of the Veterans' Administration, who assumes no responsibility for the opinions expressed or the conclusions drawn by the writers.

<sup>2</sup> K. Shinohara, *Jour. Biol. Chem.*, 109: 665-679, 1935.

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## THE METAMORPHOSIS OF DRUG RESEARCH<sup>1</sup>

By Dr. THEODORE G. KLUMPP

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THE topic which has been assigned to me for discussion is a broad one, and I am going to consider it from its broadest aspects. It is only a small exaggeration to say that any one who takes as much as an aspirin tablet for himself engages in drug research. I can speak then as one of 130,000,000 drug researchers in this country, but even at that I can only speak with the deepest humility. A short time ago our colored maid developed a cold and with it a cough. I was called upon to do something about it, and I gave her what I considered to be the best medicines available for a cough due to a cold. But the maid had more faith in a medicine of her own selection which I noticed she took to the exclusion of mine. Her faith in her medicine was its own reward and in due course of time her

cough fortunately disappeared. I would have exposed myself to polite but silent scorn if I had tried to tell her that neither my prescription nor hers cured the cough—that it would have disappeared anyway, or, as some one put it, "Nature cures the disease while the remedy amuses the patient." I might have tried to show her that man has been subject to colds and coughs since the dawn of civilization and that they have come and disappeared for countless generations before her medicine or mine had been discovered. But it would have been useless. If colds and their coughs hadn't made a habit of coming and going in precisely the same way regardless of what we did for them, man would long since have coughed himself off the face of the earth.

The element of faith has for centuries been one of the most important active ingredients in every medi-

<sup>1</sup>An address delivered before the American Drug Manufacturers Association, May 7, 1941.

cine—even though it is not declared on the label and Congress has completely overlooked it in the Food, Drug and Cosmetic Act.

Drug research had its start about a thousand centuries ago. It began before the dawn of what we choose to call civilization. For more than 995 centuries of this time the scientific method as applied to drug research was unknown. When we consider the empiricism, the "post hoc ergo propter hoc" reasoning, the stupidity that still passes for science to-day, perhaps we should find some comfort in the realization that sound scientific inquiry in this field has been practiced for less than five centuries—less than the twinkling of an eye in man's history on earth. But it is also discouragingly evident that in a thousand centuries we haven't learned much about drugs.

For untold ages disease and death were considered to be caused by evil spirits and supernatural forces. Obviously, the function of early researches was to find some sure way of warding off these spirits or placating the gods that sent them. Since disease was the doing of the gods, the only qualified experts in such matters were the tribal medicine men, who were, of course, religious functionaries. We see a hang-over of this idea even to-day, particularly in our system of medico-legal jurisprudence which looks upon schools of healing as if they were endowed with some divine right to use human bodies for the practice of their fantastic notions of therapeutics.

The first conception that disease was caused by external spirits acting by remote control later changed to the notion that the evil spirit gained access to the body and resided within it. And with it the job of the medicine man changed, too. He prescribed charms and fetishes such as amulets, rattles or the beating of drums to prevent the evil spirit from entering, or, once having entered, he tried to get rid of it by prayers and incantations. If these didn't effect a cure, he resorted to more demonstrative forms of elimination therapy such as blood letting, catharsis, leeches and opening holes in the skull. Although several thousand years have passed since these ideas predominated, they, too, still influence the therapeutic thinking of to-day. As the mind of primitive man began to free itself from the conception that disease was due to the evil eye or the wrath of the gods, he began to look around for other causes and with it other ways of dealing with them. He thought he observed that illness could be cured by many strange and wondrous means. For instance, a flannel cloth worn around the neck was believed capable of curing sore throats and whooping cough, provided the cloth was red. A horse chestnut was thought to be good as a preventive for rheumatism.

While the royal touch had only a limited vogue as a cure for scrofula, many peasants were certain that all

forms of tuberculosis could be warded off by wearing earrings. It was once believed by generations of country folk and a few that I know who were born in Brooklyn that warts were caused by toads and cured by touching them with pebbles or milkweed. Bags of asafoetida were worn around the neck to ward off asthma and croup. While most of us are now pretty sure that there is no danger of lunacy if the moon should shine on us during sleep, it is no mere ancient myth that moonshine causes plenty of trouble. But some of the ancient observations on the cause and cure of disease happened to be right. For instance, savages in widely separated countries learned of the effects of the poppy for various conditions, and cinchona for malarial fevers. The virtues of cod liver oil were recognized long before the word "vitamin" had been thought of. The diuretic effect of foxglove was known to a housewife in Shropshire before the physicians of the time recognized its merits. But all in all early experiences with drugs were empirical in nature and followed a pattern something like this:

An individual is sick.

A drug is given.

If the individual recovers, the drug effected the cure.

If the patient dies, it is easy to excuse the failure by reasoning that not enough of the drug was given, or too much was given, or it was not given early enough.

The same type of fallacious therapeutic reasoning is still commonly practiced to-day by laymen and many physicians.

It was not until the nineteenth century, a gestation period of some 999 centuries, that drug investigators fully realized that therapeutic research was not so simple a proposition. It was not enough to give a medicine to some one who was sick and see what happened. Things often did happen, but how could one be certain that the drug was responsible? Scientists gradually set up criteria by which they could distinguish coincidental occurrences from those that had a cause and effect relationship. These criteria took into consideration six fundamental propositions. They are:

(1) Many diseases and symptoms are self-limited, regardless of what is done for them.

(2) Nature heals and cures; drugs at best are merely adjuvants.

(3) Chronic diseases are characterized by spontaneous remissions and exacerbations.

(4) Symptoms are often entirely due to and almost invariably aggravated by worry and emotional disturbance.

(5) Symptoms regardless of their cause are often temporarily improved through the expectation of therapeutic benefit.

And finally,

(6) The fallacy of *post hoc ergo propter hoc* reasoning.

The tendency of the human mind to indulge in *post hoc ergo propter hoc* reasoning was said by the philosopher Kant to be the cause of all human error.

An understanding of these six fundamental propositions is basic to sound therapeutic research. The failure to take them into consideration and to set up proper controls toward this end has led to an enormous amount of misspent research. As far as the drug industry is concerned, it simply means that millions of dollars are being wasted on drug research that is unsound in its conception. It leads to the promotion of drug products on the basis of fallacious therapeutic claims which is an even greater economic waste for all concerned.

Now it is evident that when the scientific method is applied to drug research and therapeutic claims, it is possible to establish a therapeutic representation as a fact. It is something that can be demonstrated and proved with the same degree of certainty as any other factual material presented in our courts of law. But our courts, which look backward to precedent, still regard therapeutic representations as matters of opinion. Perhaps we can't blame lawyers too much for throwing up their hands in hopeless confusion when one considers the rubbish that is presented to them in the name of science. But we have available nowadays well-recognized techniques for testing the correctness of therapeutic claims. Where there is a diametrically opposed difference of opinion, it is self-evident that one opinion is right and the other wrong. Honest differences of opinion arise only because some one has failed to take into consideration the fundamental principles that apply to drug research in human beings. Where there are such differences of opinion it should not be an insurmountable difficulty to show wherein the evidence supporting one of the conflicting opinions is faulty. And in my judgment our courts have a responsibility to look behind the opinion and critically examine the evidence supporting it. Perhaps this is expecting too much of our lay courts, and the ultimate solution may be in the designation of expert tribunals to judge these admittedly difficult questions.

In the metamorphosis of modern drug research certain interesting trends are evident. Drug research started as the effort of individuals. In the eighteenth and nineteenth centuries we find contributions to drug research made largely by individuals in the course of their medical practices or as by-products of their functions as teachers in universities. From the middle of the nineteenth century, drug research has been gradually taken over by workers in universities, foundations and institutions. The medical practitioner has become increasingly aware of the fact that the ordinary practice of medicine does not provide sufficient time, material and specialized instruments for funda-

mental and well-controlled experiments. As medical research developed as the function of universities, there came into existence the so-called university hospital or the medical center, as an adjunct to the university. Here there have become available human subjects in sufficient numbers to permit well-controlled scientific studies on the cause and treatment of disease. These institutions were and still are largely private organizations supported by the philanthropy of private individuals. But we are now witnessing a gradual but nevertheless tremendously significant change in this situation. It appears to be only one phase of a vast economic movement that is sweeping over the world. Private philanthropy seems to be rapidly disappearing. A few institutions have been able to coast along on what they managed to hang on to during the economic depression, but by and large they are unable to grow and prosper on endowments that are not augmented. Instead, drug research is being increasingly supported by funds from two sources: (1) the drug houses; (2) the government, using the term in its broadest sense to include states and municipalities. And not only are the funds from these sources flowing into the coffers of our universities, but both the drug houses and governmental units are undertaking increasingly important drug research themselves. They are as never before drawing promising investigators away from the universities into their own laboratories.

Until recently drug houses have confined their efforts largely to laboratory investigations with drugs. They have turned to the universities and their hospitals for their clinical tests. In general, they have exercised little control over the development of these clinical studies except as the aim to please and perhaps attract additional funds may have influenced the investigators. I suspect that this relationship is not always satisfactory from the standpoint of the drug manufacturers, since they pay the money and yet are not in a position to control the direction of the studies. But, on the other hand, it provides what may be said to be a non-partisan, unbiased inquiry into the clinical facts. However, I venture to say that the future will see drug houses obtaining closer and more controlling affiliations with institutions having clinical facilities.

During the last twenty years the tempo of research in the fundamental sciences has been gradually increasing. Those who had a clear vision of the future recognized that the conquest of disease, premature old age and cancer was more likely to be made in the laboratory of the chemist or the physicist than in the clinic where drug research was more often than not practised as a hobby of the medical staff.

During the first quarter of the twentieth century drug research seemed to be suffering from claustrophobia, and chemotherapy in particular was in the

doldrums. But all this suddenly changed in 1932 with the discovery of the clinical usefulness of sulfanilamide. The importance of a close collaboration between laboratory and clinic was reemphasized. Sulfanilamide and intriguing discoveries in the field of endocrinology have unveiled new horizons. The sky seems to be the limit. Scientists are tackling problems of disease, such as the cause of cancer and the prolongation of life, with not only zest and enthusiasm but confident expectation that the achievements of the past are but a minor prelude to discoveries that will transform the whole panorama of life itself.

The enactment of the New Drug Section of the Food, Drug and Cosmetic Act has provided a powerful impetus to drug research. For the first time in our national history a thorough investigation of the safety of drugs before they are marketed has been made compulsory. Thousands of drug investigations are now being conducted where previously there was only a handful. Prominent pharmacologists tell me that this law has provided an incalculable stimulus to a science that was once regarded by some as a sterile cross between physiology and chemistry. Time will show, I believe, that the new drug section of the act is one of the most significant things that has ever happened to drug research in this country and the legitimate drug industry will be among the principal benefactors of its wholesome influence.

There will always be a drug industry and individual drug manufacturers. But some manufacturers will develop and prosper; others will decline. Some will see more clearly than others that the future of their companies rests more than anything else upon the research that is stimulated by them. Others will recognize, as some already have, that we can't make much progress if we have only one, two or three bright young chem-

ists shut up in a laboratory, putting along on problems that are as vital as health and life, and at the same time somewhere else in another laboratory, one or two other chemists going over exactly the same ground, as out of touch with the first group as if they were working on another planet. The sooner we realize that the day of the brilliant individual investigator working alone in a hermetically sealed compartment is gone forever, the sooner will we solve problems that are far more important than the tensile strength of steel, nylon stockings, synthetic rubber or a horsepower per pound of airplane engine.

The problems of drug research are more complex than they used to be. Progress in the future will come increasingly from the collaborative efforts of groups of individuals, working under the leadership of those who have imagination and minds fertile with ideas. The brilliant investigator is indispensable, but he must have the tools to work with and the help of assistants who will act as test pilots for his ideas. There must also be a harmonious integration of the work of chemists, physicists, physiologists, pharmacologists and clinicians to produce results. I think it is about time that medicine and the drug industry gave up its small-time amateurish attempts at drug research. I think we should go to the du Pont Company, the United States Steel Corporation, the General Electric Company and the Firestone Rubber Company and see how they tackle their research problems. We must enlist the brains, the imagination and the ingenuity of thousands of chemists, physicists, pharmacologists and clinicians to solve these important problems of life and health. They are the problems that count, for without a long life and health, it really doesn't matter much whether we have nylon stockings or synthetic rubber or stratosphere planes or anything else.

## ASPECTS OF MODERN PSYCHOLOGY. II

By Dr. CHARLES S. MYERS

ENGLAND

LET US now return to the fate of the psychology founded by Wundt which directly concerned itself in observing mental experience and in reducing it to its elementary terms of sensation and feeling. His former pupil, Külpe, met with Wundt's violent opposition when at Würzburg he began to study experimentally and introspectively the processes of thought, paying particular attention to the acutely living *acts* of judging, valuing, denying, etc., and not only to the relatively lifeless *stuff*—"bundles" of sensation, percepts, images and thoughts. In Paris, Binet had already detected the occurrence of thinking without images, verbal or concrete. Külpe's school also insisted on introspective grounds that meaning was possible in the

absence of images (and hence of sensations). Wundt protested that such inquiries were beyond the scope of introspection, and Titchener, endowed with vivid imagery, maintained that anyhow introspection in Külpe's school must be defective, as he himself could always detect kinaesthetic imagery in all meaning. Meaning, he said, is invariably "context"; it involves a bodily attitude of the individual facing the situation; and psychologically meaning is the characteristic kinaesthetic experience aroused by that bodily attitude. Few psychologists will now insist that meaning must have a sensational (or imaginal) basis, or that thought must always have imagery as its vehicle.

Equally important was the experimental evidence

adduced by Külpe's school in favor of the wide influence of the "determining tendency" and "attitude" which, once set up, influence the nature and direction of future mental processes. We try in vain to recall a forgotten name: this effort evokes a "determining tendency" that continues to act unconsciously until, it may be, more favorable conditions being established, the forgotten name arises unbidden to consciousness. Or again, when the figures, say, 3 and 9, are presented to us, we may by "chance" association at once think of 12 or 27 or 6 or 3; but if previous instruction has given our minds a "set" in the direction of addition or multiplication or subtraction or division, an "attitude" has been formed which will result not in *any one* of these numbers, but in the *appropriate one* of them, at once appearing in consciousness.

A determining tendency is something very different from an associative tendency. It is a purposive perseveration, a goal-seeking drive, capable of using alternative mechanisms for procuring its end, whereas an association is a mere coupling or mechanical connection, of variable strength, rigidly uniting the terms *a* and *b* associated. Obviously, as has been urged already, mere association strength is not sufficient to explain the results of mental activity in daily life. Repetition of *a* and *b* merely increases the strength of such connection, whereas with purposive activity and, in particular, the determining tendency (to use an example of Lewin's, where *a* is the desire to post a letter, and *b* is the sight of a mail box) the connection virtually or wholly ceases when once the goal has been achieved.

But it would be absurd to assert that association plays little or no part in the operations of the mind. Yet this of late has been the tendency of certain schools of psychologists who have rightly recognized its limitations. Laboratory experiments with senseless syllables show irrefutably that under these abstract, artificial conditions the process of association takes place in learning them and indeed that the strength of association and perseveration are the principal factors determining their recall. Under more natural conditions, however, when sensible material has to be learnt, the mechanical process of association is overshadowed; but even here it becomes more prominent, the simpler and the poorer in meaning be the material that has to be learnt, the simpler be the mind of the learner, or the less liable be what has been learnt to the distortions of interest and to the perspective influences of what F. C. Bartlett has termed "schemata."

It is similarly absurd to condemn sensations to non-existence in a diatribe against the dangers of the crude mosaic atomism to which I have already directed attention. We know perfectly well from experience

what a fairly pure sensation is and how it differs from a perceived object. We may be ready to admit that percepts are not built up mosaically out of sensations, that, on the contrary, vaguely meaning percepts came first in the developing experience of the infant and that pure sensations came later to be differentiated from them by abstraction. But it would be ridiculous to deny that mental life is served by integration as well as by differentiation. I recall the experience of an artist friend of mine who was painting a street in the bazaars of Cairo. Behind him stood a crowd of *fellahin*, gazing in astonishment at his work. At length he heard one of them, presumably of higher intelligence than the rest, slowly say, "That's a door, that's a window, there's a roof," and suddenly, "Why it's a house!"

In rebellion against the extravagances of mosaic atomism and of associationism, nevertheless, and welcoming introspection, the *Gestalt school* was founded by Wertheimer, with the energetic support of Köhler, Koffka and Lewin, all four of whom have found a happy refuge in the United States of America from recent German intolerance. The importance of form, shape and pattern has also been incorporated into Krüger's school of *Entwicklungspsychologie*, succeeding Wundt's, at Leipzig. The *Gestalt* psychologists have studied the laws determining the forms, and the stability and changeability of the forms, of optical figures, and the relation between the figure and the ground from which it stands in relief or in which it may be almost unrecognizably imbedded; and they have applied these laws also to conditions affecting certain intellectual and conative processes. They have studied the occurrences and the dynamics of what they interpret as *Gestalten* in the physical field; they have claimed to find analogies between these *Gestalten* and those in the psychological field; and indeed some have tried to trace physiologically corresponding, "isomorphic" patterns (with their stresses, tensions and pictorial vectors) within the sensory and nervous systems (in terms of electric potential or osmotic pressure)—a psycho-physical parallelism in *Gestalten* which it is hard to accept in any strict sense when meanings, values, traits, drives, purposes and personalities are considered. Stern, suspicious of a repetition of a mosaic of entities, here of *Gestalten*, once criticized this school in the words "Kein Gestalt ohne Gestalter." But of late Lewin, one of its leaders, has been busy trying to "patternize" personality itself, and has been likewise treating the environment in a "topological" way, introducing an applied "mathematical topology" and endeavoring apparently by a development of *Gestalt* and dynamic psychology to found a school of *topological psychology*.

Like others who have become habituated to any one

outlook, the *Gestalt* school tended at first to belittle every other outlook and to bring within its ambit too much that would more readily and with greater likelihood be explicable in other terms. To study patterns already formed need not involve neglect of, or contempt for, the study of the parts apart from their combination. It may well be, as the *Gestalt* school urges, that the true significance of any part of a whole can not be realized until the properties of the whole are understood. And it is unquestionable that errors of interpretation ensue from the study of abstract "vivisectioned" parts of the whole mental (as of the nervous) system. But whatever the size of the whole that is investigated, it must in practice be only a part abstracted from a still larger whole.

Lewin does not share the view that psychology need use the same dynamic concepts as physics uses, nor that all psychological explanations need rest ultimately on physical facts; he does not see the necessity for accepting "the philosophical Utopia of a single universal science." The "topological" concepts which he introduces in the form of spaces, boundaries, distances and directions are mathematical, not physical in nature. They represent, he tells us, an attempt to treat psychology by means of applied mathematics, using a concept of space (developed by mathematics from the part-whole relationship) which is by no means identical with physical space—thus providing a visual and dynamic representation of behavior which is for him a function both of the person and of his environment. "Topological" space implies that we are dealing with mathematical relationships which can be characterized without measurement.

Whether we can by Lewin's methods replace anthropomorphic explanations by purely mathematical concepts and relations of this attractive and promising kind must be left to the future. The problem is conceived in a clearly different spirit from that which in physics causes controversy between experimental and mathematical physics, and from that which faces the measurement of psychical processes (*e.g.*, of sensation by Fechner and of abilities by deviations from the average scores at mental tests) and the determination of unit mental abilities or qualities by the mathematical methods of factorial analysis. There is a general agreement that sensations can not be measured, at all events in the same sense as physical objects; and that Fechner's law can only be reached by the aid of mathematical operations which treat the symbols in utter disregard of what they psychologically stand for. The psychological standpoint is deliberately discarded during the application of such mathematical methods, and thus the resulting formula, though not without its uses, is not without its difficulties.

The labors of the schools of *factorial analysis*, espe-

cially of Spearman, Thomson, Stephenson and Burt in Great Britain and of Thorndike, Thurstone, Kelley, Hotelling and others in America, will undoubtedly bear useful fruit. But the concept of mental factors, like that of faculties long ago, needs to be carefully watched. Can the mind be in complete truth conceived as having a structure of ultimately independent unit factors, some "general" to a very large number of mental processes, others perhaps common to a comparatively small "group," others "specific" to particular mental processes? Is character, for instance, to be conceived as an aggregate of separate traits and other unit factors? Are the units independent of the whole? Has the whole no influence over the complexion of its parts?

When in factorial analysis we determine the correlation between any two abilities, we are correlating the scores made at pairs of tests, that is to say measurements of *behavior*, of outward expression or movement. How can we legitimately pass from this to the correlation between *psychological* processes? Any one mental test (like any complex muscular action) can be performed by any one person now in one way, now in another, using different mental abilities (as, in the case of complex movement, using different muscles) to achieve the same end. And when the factors have been mathematically analyzed, what is their *psychological* nature? This can only be guessed at, and the guesses confirmed by their proven utility. Then, again, what psychological warrant have we for the various mathematical steps we take in factorial analysis? Have they at each stage strictly psychological meaning, or are we neglecting this for purely statistical operations which end with results that relate to the average, but have no precise reference to any individual member, of the group? And yet in some general way, for broad common traits and for the total group, factorial analysis, like the enumeration of a few common instincts, proves useful and deserving of encouragement, although it must fail for the unique characters of the personality of the individual. In this direction there is greater promise in a variant of factorial analysis which has been specially urged by W. Stephenson and C. Burt. Here pairs of tests applied to a group of persons are replaced by a group of tests applied to pairs of persons.

Factorial analysis has already indicated the likely truth that special abilities are less highly differentiated from one another in early childhood than at adolescence, thus providing analogy with the view, supported by experimental evidence, that in the developing organism the central nervous system is originally undifferentiated in function as well as being relatively structureless. As Coghill has stated, "dominant organic unity," "undifferentiated reactions of the whole organism," are present from the beginning: the form

of the pattern of behavior is not "simply a combination or coordination of reflexes" originally isolated from each other.

One outstanding difficulty is that the number of factorial units analyzed from any one set of data depends on the nature of the mathematical operations employed. Herein the various schools of factorial analysis at present differ, reaching interpretations of any specific investigation as different from one another as the schools of Freud, Jung and Adler in their analysis of the role of the unconscious would reach in any particular case. For Spearman factorial analysis yields each time but two factors—a "general" factor known in some circumstances as general intelligence and a "specific" factor peculiar to each ability. Associated with this finding has developed his *neo-genetic school*, which refuses any countenance to *Gestalt* principles and spreads its net far more widely than can be suitably covered by its two most important principles—the "eduction of relations" and the "eduction of correlates." Their value is particularly evident in clarifying the definition of general intelligence.

Wherever we turn, whatever methods we consider, it would seem that both the total wholes and the component parts require appropriate study in order to arrive at a true and complete psychology. Once again, we are forced to the conclusion that psychology needs to be studied not only from the mathematical and the mechanistic but also from the humanistic and teleological standpoints, and alike from the introspective, behavioristic and *Gestalt* standpoints, according to the purpose which the study is intended to serve and the conditions under which the study is undertaken.

At a time when physicists are complaining that they do not know now what mechanism means nor what matter means, when many of them realize that what "scientific" or mathematical investigation has to say about the universe represents by no means all that is significant about it, when biologists recognize self-conservation—the struggle of organisms for their existence—and are no longer confident about the blindness of evolution, it would be rash to condemn any standpoint or any school of psychology among those we have examined. We may justly complain that any single current concept, *e.g.*, that of the reflex, of association, of *Gestalt*, or of factors, is inadequate, and that broader or multiple concepts are desirable. At the present time we observe a growing tendency of these schools to welcome each other's features that can usefully blend together. Orderliness and teleology are not inconsistent with one another: generalization and individuation are of equal importance. We have good reason, in view of the many-sidedness of psychology, to welcome, not to deride or to suspect, the active energy displayed by its various schools—so long as intolerance, injustice and the other evils common to dictatorship and totalitarianism are avoided. We have only to look back a half-century to realize the enormous strides that psychology has made, in refinement and expertness of introspection, observation and interpretation, in delicacy of discriminating terminology, in the conception of the unconscious, in the application of mathematical methods, diversity of aims, concepts and methods of approach and in the rich harvest that has resulted from the uses of psychology as an applied science.

## OBITUARY

### EUGENE DAVENPORT

EUGENE DAVENPORT was born in Woodland, Michigan, on June 20, 1856, and died in his old home on March 31, 1941. His parents were pioneers and the boy was brought up under pioneer conditions. While helping his father on the farm as a lad he made up his mind to get a college education. In due time he entered the Michigan State College of Agriculture, receiving the B.S. degree in 1878. This was followed by the M.S. in 1884, the M.Agr. in 1895 and the LL.D. in 1907. In 1920 Iowa State College conferred on Dean Davenport the LL.D. degree, as did the University of Kentucky in 1913 and the University of Illinois in 1931.

The ten years immediately following his graduation from college were spent in operating the home farm. In 1881 he married Emma J. Coats. They had two children, one of whom died in infancy. In 1888 he was appointed assistant botanist at the Michigan

Agricultural College and Experiment Station and the following year was made professor of practical agriculture and superintendent of the college farm, a position which he held for two years. The year 1891-92 was spent in São Paulo, Brazil, as president of the Collegio Agronomica. Owing to the failure of that institution to receive government support, Dr. Davenport returned to the United States and in 1895 and 1896 was appointed dean of the College of Agriculture and then director of the Experiment Station of the University of Illinois. Here his great career really began. His task was to build a college and put agricultural education on a college level. In order to accomplish that purpose it was necessary to change public sentiment in the state.

When Dean Davenport went to Illinois there was a college of agriculture only in name. It was not that there was no work in agricultural education being done, but it was on a low level and wholly unsys-

tematized. There were only a few students. He found opposition both in and out of the university. The prevailing opinion was that the farmer did not need education, or if he did it should be vocational in a narrow sense. Dean Davenport had a different view. He believed that every young person should be educated both culturally and vocationally. He often remarked that what is technical and professional to one is humanistic to another and that "every man to be efficient needs the vocational; to be safe and happy he needs the other." He held the view that the country needed not "half men" but "whole men" in the sense that each should be man, citizen and farmer.

These views led the dean to insist on a college level for agricultural education and to oppose separate vocational schools. He insisted on a single system of secondary schools in which the people of all classes should be educated together with different courses of study for different classes.

He worked through the earlier years to get these views accepted before he could get the necessary support. As one of his colleagues has remarked: "Thus did Dean Davenport exert his powerful faculties towards seeing that instruction of less than college grade should be broadly developed in the secondary schools and that it should be developed as a part of a unified system of secondary education. Perhaps this is the most significant contribution which the university has made in the development of agricultural instruction at the sub-college level."

Public sentiment slowly changed, influential farmers were converted and through their support adequate appropriations to develop the college and experiment station were secured and an agricultural building was finally erected in 1900. The dean soon gathered around him an able staff in both the college and the experiment station.

From researches conducted in the experiment station have come discoveries that have added largely to the welfare of the people of the state. Without lessening in the least degree the credit due members of his distinguished staff, it may be truly said that Dean Davenport participated in every line of investigation, although he always gave the credit to others. He took an active part in developing the system of permanent agriculture, the soil survey and many other research projects. Concerning the policy of a permanent agriculture he wrote: "It can easily be shown that good farming which cares for the soil by restoring fertility as fast as it is taken out, can be made to pay the farmer better over a period of years than poor farming which destroys fertility."

Dean Davenport's views on education and agriculture are set forth in four books and numerous pam-

phlets. The books are: "Principles of Breeding," "Education for Efficiency," "Domesticated Animals and Plants" and "The Farm." These volumes and the numerous addresses frequently given in the state led in a few years to a complete change of attitude on the part of the farmers towards higher agricultural education. Indeed, so great was the change of public opinion that, as the dean often told me, he found it necessary at times to check impulsive projects designed to stimulate more rapid development. He always succeeded in this, even to preventing a movement for separating the College of Agriculture from the rest of the university. The confidence of the people in his judgment was deep and wide-spread. Indeed, it may be said of him that the College of Agriculture was in reality a creation of his own. The confidence of the people rested not only on the obvious sanity of his plans, but also on the fact that he had a thorough knowledge of practical farming and could speak to the farmers of the state as one of themselves.

When the World War came to us in 1917, Dean Davenport took an active part as an adviser of Mr. Hoover in promoting a good policy for the country. He and his colleagues outlined such a policy with the idea of having their proposal enacted into law. At the dean's request I personally took their recommendations to Washington, where they were incorporated into a bill and introduced in one of the houses of Congress. However, it was obviously desired to have such a project originate with the existing administration. Therefore the bill was never brought to a vote, although the policy finally adopted was substantially that embodied in the bill.

A true estimate of Dean Davenport as a citizen and educational leader can not be formed without a glimpse at what may be called his social philosophy. This is well set forth in the latter part of his last book, "The Farm." He remarks: "The conscientious farmer will remember that while his first duty is to himself and his family, yet, after all, he holds his land in trust because the man who comes after him will also have a family and will also have problems of his own to be met. He has no more right to skin the land for his own profit than has a business to issue long-time bonds for expenditures whose benefits will be gone before the people are born who will pay the bonds." This is an application of the sound doctrine that in industry and the professions the element of the public interest is always present and should never be forgotten.

The dean had some views in these later years on the Federal agricultural policy. He praised the liberal policy of previous years which promoted agricultural education and such projects as flood control, drain-

age and similar activities. He believed, however, that "To go further than this and attempt to coerce in the management of land, as is often suggested, is of doubtful expediency. . . . One thing is certain, agriculture can not be hampered by any form of gigantic administrative machinery, governmental or private." To the end he believed in individual initiative and self-reliance as the primary conditions of success. He expressed these views to me in his home only a few months before he died.

Dean Davenport also had pronounced views on the international situation. In an article written for the United States Boys' Working Reserve during the World War, he wrote: "Unless we win this war, all the world will work for Germany. She has a definite plan for the conquest of the earth, a piece at a time, and whosoever she conquers will be bled white. . . . Germany has been getting ready for this war for forty years." He quotes Bismarck as saying, "For a hundred years war must be the chief industry of Germany, and every war must pay for itself with a profit." So the dean goes on to remark, "Germany has threatened to bleed France and England and America, and so she will in good time if she comes out of this war with her army." These words might have been written in 1940 instead of 1917.

Dean Davenport did not limit his interest to education and agriculture. He was interested also in the fine arts and the proper use of leisure. Once in a while he emphasized his interest in the latter by taking extensive tramps with his family in various parts of our western land. "Vacation on the Trail"

is a delightful story of their experiences in high mountain trails and a fine illustration of a good use of leisure.

Broadminded, liberal in his views, always courteous, helpful in his attitude, sound in his judgment and devoted to his ideal of duty, he was a tower of strength in the University of Illinois and the agricultural circles of our country. His influence will last down through the years.

DAVID KINLEY

URBANA, ILL.

## RECENT DEATHS

DR. GEORGE ELLETT COGHILL, member of the Wistar Institute of Anatomy, Philadelphia, where he was from 1925 to 1935 professor of comparative anatomy, died on July 23 at the age of sixty-nine years.

FREDERICK WILLIAM HEHRE, head of the department of electrical engineering at Columbia University, died on July 27.

THE *Journal* of the American Dental Association reports the death of Dr. Robert Boyd Bogle, Nashville, on May 25; Dr. Edward Jay Tinker, Minneapolis, on May 8, and Dr. John Albert Marshall, San Francisco, on May 7.

PROFESSOR THOMAS GIBSON died at Kingston, Ontario, on July 2 at the age of seventy-five years. At the time of his death he was professor of the history of medicine and earlier was professor and head of the department of pharmacology of Queen's University, Canada.

## SCIENTIFIC EVENTS

### AMERICA AND BRITISH SCIENCE

DR. H. H. DALE, director of the National Institute for Medical Research, London, and president of the Royal Society, has sent the following communication to *The British Medical Journal*:

Some of your readers may have seen my letter to the *Times* of June 20, on the generous gifts recently made to the Royal Society by scientific societies of the United States of America—an earlier one of \$10,000 from the American Philosophical Society "for the aid of science in Britain," and now, last week, a gift of \$5,000 from the American Physiological Society "for the support of scientific publications in Britain, especially in physiology."

A natural and helpful comradeship between medical men of different countries has always been at least as strong among the physiologists as among those whose work is in other branches of medical science or practice. Certainly we British physiologists are on terms of sufficient intimacy with our American colleagues to know well that the American Physiological Society, like our own,

depends for existence and support on the efforts and the contributions of members who are working men of science. Their gift will assuredly have a direct importance for the object which they named in making it; but while we gratefully recognize its immediate and intrinsic value, we shall not miss the wider meaning of the fraternal impulse which determined this fine and generous action. We shall be sure that it symbolizes a desire of our American friends to share with us, as far as national policies allow, in the losses which are being encountered in defence of ideals which are theirs as much as ours.

Such gifts, indeed, are among many signs of the fuller understanding which comes with the recognition of a common peril and a common duty. An interchange of medical personnel has begun. The generosity of the Rockefeller Foundation is enabling a chosen batch of students to go to American medical schools; there must certainly be more of such interchange after the war, and in both directions. Qualified American medical volunteers are arriving in this country. Close collaboration in scientific researches more directly concerned with warfare has for some time been

a necessary and well-established condition of America's share in the equipment of our forces. Surely it is clear that the greatest gain which can come to us, and to the world, from a war in which so much has been and must yet be sacrificed, is this closer and more conscious unity between peoples who have always been bound together, not merely because they speak the same language and share so much of history and tradition, but because their ideals and their outlook on life are, in very truth, essentially identical. To see in the promotion of such unity the best hope for the future, to work for it in every way and to guard it from the weakening effects of sectional aims and factitious differences, seems to be the best acknowledgment that the medical and scientific men of Britain can at present make to the American colleagues who, with a noble and simple generosity, are showing their desire to be identified with our cause.

### THE INSTITUTE OF TECHNOLOGY OF NORTHWESTERN UNIVERSITY

It is expected that the new building of the Institute of Technology of Northwestern University, erected at a cost of \$6,735,000, which was made possible by a grant from the Walter P. Murphy Foundation, will be opened in the autumn. The institute is conducted on the cooperative plan, under which students alternate work in industry with study in the classroom on a quarterly basis. The first class entered in the autumn of 1939.

In the new building there is an air-distribution room, where the mercury will reach zero, designed so that smaller rooms may be constructed within, thus permitting control of external temperature. This room will test for air leakages, insulation defects and strain upon building materials.

The cold room for civil engineering, to which specimens of cement, concrete, steel and building materials will be brought for analysis, is a heavily insulated 6 by 7 foot laboratory, in which quick changes in temperature will subject materials to the most rigorous of tests.

A low temperature research room is being built for the department of mechanical engineering. In a compartment large enough to house an automobile, the temperature may be driven to 75 degrees below zero. Tests will be conducted under these conditions of moving engine parts. The room is insulated with twelve inches of cork. It is tile covered and separated by an air space from the ground beneath. The latter permits the floor to expand or contract as the temperature varies.

Special research in low temperatures is planned for the cold room of the department of physics, where temperatures of 20 degrees below can be produced. In addition, chemistry will have two "variable temperature compartments," which will reach 4 degrees

below. These rooms will serve the purpose of storing organic samples which need to be kept frozen.

Besides the so-called "cold rooms," there will be thirty-two controlled temperature rooms, cooled by a seventy-five horse-power air conditioning machine in the basement. These will be used for a variety of experiments calling for specific temperatures.

Approximately \$1,000,000 worth of new equipment is now being installed. This includes apparatus for producing lightning and rain to test insulation and electrical equipment, "bomb rooms" with 12-inch walls to guard against explosions from experimentation, an artificial river to test boat models and vibrationless rooms which float in space.

### THE NATIONAL FOUNDATION FOR INFANTILE PARALYSIS

The distribution by the National Foundation for Infantile Paralysis of grants amounting to \$195,030 with which to carry on its battle to conquer infantile paralysis has been announced by Basil O'Connor, New York, president of the foundation.

These grants include:

A grant of \$40,000 to the newly organized School of Public Health at the University of Michigan, which continues aid given to the school to create facilities for the study of virus diseases and to train virologists, with particular emphasis on infantile paralysis; also a grant of \$7,400 has been made to the department of pediatrics of the university for the purpose of investigating the various forms of treating experimental infantile paralysis by the use of biologic and chemical agents.

A grant of \$4,250 has been made to the Medical School of the University of California, San Francisco, to continue a study involving precise analysis of the movements of the various joints of the body, a project of particular importance in the treatment and prevention of after-effects of the disease.

A study aimed at determining the disposition of the infantile paralysis virus neutralizing antibodies among residents of an urban community, under what circumstances and at what rate persons develop such antibodies and the correlation of these data with the occurrence of infantile paralysis will be made under a grant of \$9,300 to the School of Medicine of the Johns Hopkins University.

Two grants amounting to \$6,300 to the Children's Hospital, Boston, will make possible the continuation of a study aimed at determining the effects of infantile paralysis on the growth of lower extremities. A study of the gastrointestinal tract as the portal of entry of the virus in paralysis will be made under a grant of \$3,000 to the Boston City Hospital. Under a grant of \$9,200, the Strong Memorial Hospital, at the University of Rochester, will continue studies to determine the functional indices in normal and abnormal locomotion. The University Hospital of the State University of Iowa, under a grant of \$7,100 will continue an evaluation of treatment in the

return of muscle function and the prevention of deformity in acute and subacute infantile paralysis. Two grants amounting to \$7,930 to Michael Reese Hospital, Chicago, will permit a continuation of previous studies in various aspects of the treatment of infantile paralysis and some aspects of the after-effects of the disease.

Grants amounting to \$23,400 have been made to the National Organization for Public Health Nursing, New York, one of them to continue a previous grant to encourage nurses with desirable qualities to prepare themselves for the field of orthopedic public health nursing; another will continue aid to provide seven scholarships in orthopedic nursing care. A grant of \$8,500, made to the National League of Nursing Education, New York, will provide instruction of nurses whose main interests are the care of orthopedic patients in institutions.

Other grants include \$5,600 to the University of Minnesota; \$4,980 to the department of bacteriology and parasitology of the University of Chicago; \$5,000 to the department of bacteriology of the University of Southern California; \$13,900 to the Bureau of Laboratories of the Michigan Department of Health; \$5,300 to the City Hospital at Cleveland, and \$12,000 to the New York State Department of Health. Smaller grants are made to various institutions.

### SURVEY OF INDUSTRIAL RESEARCH

A COMPREHENSIVE report by the National Research Council on "Industrial Research" has been transmitted to Congress by the National Resources Planning Board. The document is one of a series on Research Resources being prepared by the National Resources Planning Board with the assistance of scientific councils and committees.

The survey was conducted by members of the National Research Council as operating agency of the National Academy of Sciences, with funds provided by the National Resources Planning Board. A committee of the council responsible for the survey, with F. W. Willard, president of the Nassau Smelting and Refining Company, as chairman, was composed of industrial executives, research directors and representatives of universities active in industrial research. The immediate direction of the survey was placed by the council in the hands of Raymond Stevens, vice-president of Arthur D. Little, Inc., of Cambridge, Massachusetts. With him were associated Dexter North, of Washington, D. C., and Dr. Caryl P. Haskins, president of the Haskins Laboratories in Schenectady, as assistant directors of the survey. Representatives of the interests of industrial laboratories, universities and special research institutions prepared sections of the report.

It is pointed out that the continuous and increasing application of science by industry is "contributing

most significantly to the high standard of American living." American industry employs more than 70,000 workers in over 2,200 laboratories at an estimated annual cost of \$300,000,000. Industrial research is generally accepted "both by informed labor and by informed management as a desirable and constructive force." "Organized labor is officially on record in favor of research and the annual reports of many of the most successful corporations have stressed the relation of research to earning power."

Among the findings set forth by the committee are the following:

Industrial research is possible for all industrial units, small and large. The distribution of research in industry seems to follow no definite rule but to depend rather upon management policy. It is apparent that research is most active in companies utilizing technically trained men in design, production or sales activity.

Industrial research acts as a protection against unfavorable changes taking place both within and without an industry. Industry looks to the universities for trained technical men, and for principal advances on the frontiers of science. However, it is of interest that advances are not infrequently made on these frontiers in the course of research projects originally designed to achieve immediate commercial objectives.

The United States is now virtually independent of foreign sources for adequate apparatus and facilities for laboratory research.

It is recommended that leaders in several industries take steps toward initiating research programs where they do not now exist. There are wide variations between amounts spent in various industries, the chemical industry leading in the percentage of income devoted to research.

One portion of the report deals with the extent to which the recognized disciplines of science—physics, chemistry, mathematics, metallurgy, the several fields of engineering, biology and borderline fields—are applied in different industries.

It is pointed out that:

In several branches of pure and applied science, abstracts of the technical literature are supported by scientific societies. Such support is becoming increasingly burdensome and increasingly inadequate in the face of the enormous and rapidly expanding amount of technical matter being published. An excellent means of Government contribution to industry would be proper provision for systematic and complete publication of abstracts of scientific and technical literature.

Extension of research means increasing dependence upon adequate and correct standards of reference. Establishment of standards requires most exacting and long-continued laboratory work, a high caliber of technical personnel, and, frequently, expensive facilities. There is need for much more research on standards of measure-

ment than is now conducted, and it is recommended that the National Bureau of Standards be given encouragement and increased tangible support for research on standards. It is also recommended that any appropriations for such support provide ample funds for adequate publication and distribution of the Bureau's findings.

In transmitting the report to President Roosevelt, the National Resources Planning Board said: "We endorse in principle the findings and recommendations of the special committee and wish to call attention to the great importance of industrial research in

relation to both the present defense effort and also to developments in the post-defense period."

In a letter to Dr. Frank B. Jewett, president of the National Academy of Sciences, and Dr. Ross G. Harrison, chairman of the National Research Council, Mr. Willard said: "It is my duty to record here the gratitude of your committee to the leaders of private enterprise in the United States of America who have, without exception and without reservations, responded to your committee's request for information. Lacking this wholehearted cooperation, your committee's task could not have been performed."

## SCIENTIFIC NOTES AND NEWS

DR. JEROME C. HUNSAKER, head of the department of mechanical engineering at the Massachusetts Institute of Technology, has become coordinator of research and development for the Navy. He will be assisted by a special board, to be composed of representatives of the chief of naval operations and the commanding officers of the Bureaus of Ships, Ordnance, Aeronautics and Yards and Docks.

DR. WILLIAM F. DURAND, professor emeritus of mechanical engineering at Stanford University, has been appointed a member of the National Advisory Committee on Aeronautics. He succeeds Dr. Robert E. Doherty, president of the Carnegie Institute of Technology, who resigned his membership on July 3 to become chairman of the Production Planning Board of the Office of Production Management.

THE medal of the Society of Chemical Industry has been awarded to Dr. Elmer K. Bolton, chemical director of the E. I. du Pont de Nemours and Company, in recognition of his work in connection with the development of neoprene, nylon and synthetic rubber. The medal "may be awarded annually to a person making a valuable application of chemical research to industry."

THE Rivers Memorial Medal for 1941 of the Royal Anthropological Institute of London has been awarded to Dr. Diamond Jenness, ethnologist of the National Museum of Canada, for his work among the Eskimos of Arctic America. The Wellcome Medal for 1940 has been awarded to Dr. Audrey I. Richards for her essay on "Bemba Marriage and Present Economic Conditions." Dr. Richards has filled the post of lecturer in social anthropology at Bedford College for Women, the London School of Economics and the University of Witwatersrand. She has made anthropological expeditions to study the tribes in Northern Rhodesia.

THE honorary degree of doctor of letters was

awarded at the commencement exercises of Jefferson Medical College, Philadelphia, to Dr. John M. T. Finney, emeritus professor of surgery at the School of Medicine at the Johns Hopkins University.

FRANK B. COOPER, research chemist at the Institute of Pathology of the Western Pennsylvania Hospital, Pittsburgh, received an honorary doctorate of science at the sixty-fifth annual commencement of Grove City College, Pa.

AT the commencement exercises of the Philadelphia College of Pharmacy and Science, the degree of doctor of science was conferred on Dr. Victor O. Homberg, formerly a member of the department of chemistry of the Massachusetts Institute of Technology, and on C. P. Dubbs, of Chicago, in recognition of "his outstanding contributions to the field of industrial chemistry."

A PORTRAIT of Dr. Torald H. Sollman, professor of pharmacology and materia medica at the School of Medicine of Western Reserve University, given by six hundred alumni and friends, was presented to the university during commencement week. A book containing the names of those who gave the portrait was presented to Dr. Sollman.

THE thirtieth anniversary of Dean R. B. Dillehunt's joining the faculty of the University of Oregon Medical School was celebrated on July 10 by a faculty dinner and by the unveiling of a portrait.

IN a wireless dispatch to *The New York Times*, dated July 5, it was stated that Dr. Carrel had been commissioned by the Vichy government to organize in France in the occupied zone an institute for scientific and medical research. This dispatch was quoted in *SCIENCE* for July 11. We are informed that this information is not correct. Dr. Carrel is at present in occupied France. He fully intended to return to

New York after completing the investigations that he undertook on his own responsibility of the effects of malnutrition and infectious diseases in Spain, France and Belgium, especially among the children.

ACCORDING to *The Lancet*, the following have been appointed to the council of the Imperial Cancer Research Fund for the ensuing year: *Chairman*, Professor H. R. Dean; *Vice-chairman*, Sir Cuthbert Wallace; *Elizabeth Wills Allen Fellow*, Dr. L. Foulds, and *Alice Memorial Fellow*, Dr. R. J. Ludford. Professor James Young has been appointed a governor of the fund by the Royal College of Surgeons of Edinburgh, and Professor T. J. Bosworth, by the Royal Veterinary College and Hospital.

At the annual general meeting of the Marine Biological Association of the United Kingdom, Professor J. Gray was elected chairman of the council in place of Professor E. W. MacBride. Other officers were reelected.

PROFESSOR LEON BRILLOUIN, of the Collège de France, will be in residence as visiting professor of physics at the University of Wisconsin for the academic year 1941-42. He will offer, in addition to other courses, a series of lectures on short radio waves, their properties, generation, propagation and applications.

DR. ALBERT H. PALMER, formerly of New York University, has been appointed Smith, Kline and French Laboratories research fellow with the rank of assistant professor in the department of agricultural and biological chemistry at the Pennsylvania State College. He succeeds Dr. William G. Gordon, who has joined the staff of the Protein Division of the Eastern Regional Research Laboratories in Philadelphia.

DR. WILLIAM ALLAN, Charlotte, N. C., has been appointed head of a department of eugenics at the new Bowman Gray School of Medicine of Wake Forest College, N. C., which is to open in Winston-Salem in the autumn. The department will be financed by a grant from the Carnegie Foundation of New York.

DR. FRANK HORTON, professor of physics in the University of London, has been reelected vice-chancellor of the university for the year 1941-42.

PROFESSOR H. MUNRO FOX, since 1927 professor of zoology in the University of Birmingham, has been appointed to succeed the late Professor George A. Boulenger as head of the faculty of zoology at Bedford College, London.

At the Cornell University Medical College, New York City, Dr. Eugene L. Opie has been made emer-

itus professor of pathology; Dr. John C. Torrey, emeritus professor of epidemiology, and Dr. Joshua E. Sweet, emeritus professor of experimental surgery.

DR. HARRY MILLER LYDENBERG, director of the New York Public Library since November, 1934, and a member of the library staff since July 1, 1896, has resigned. He will be succeeded by Franklin Ferguson Hopper, chief of the circulation department, who joined the staff of the library in 1914.

THE Rockefeller Foundation has made a grant to the University of Oxford of £900 for the Nuffield department of surgery to pay the salaries of Dr. Eric Guttman and a trained social worker in psychiatry. Dr. Guttman will carry out an investigation into brain injuries. The university is making a grant to the department of biochemistry to carry out a nutritional survey and a study of antiseptics in relation to burns.

STANFORD UNIVERSITY has announced a gift of \$65,000 from the Rockefeller Foundation to finance a five-year program for the development of the electron microscope. It will be under the direction of a committee including Professors Philip A. Leighton and J. W. McBain, chemistry; E. W. Schultz, bacteriology; C. V. Taylor and L. R. Blinks, biology; D. L. Webster and Paul Kirkpatrick, physics; Fred Terman and Karl Spangenburg, electrical engineering. Dr. L. Marton, formerly of the University of Brussels, who came to the United States in 1938, has been appointed associate professor of electron microscopes. Dr. Marton has been working in the R.C.A. Research Laboratories at Camden, N. J.

DR. ROY E. CLAUSEN, professor of genetics at the University of California, has spent six weeks in Hawaii as the guest of the three agricultural experiment stations in Honolulu: the Hawaii Agricultural Experiment Station at the University of Hawaii, the Experiment Station of the Hawaiian Sugar Planters Association and the Experiment Station of the Pineapple Producers Cooperative Association. During this time he gave a number of lectures and consultations on subjects of genetics and plant breeding.

PROFESSOR RENÉ WURMSER, of the Institut de Biologie and of the Sorbonne, Paris, has now taken up his post in Rio de Janeiro, at the Laboratório da Biofísica of the faculty of medicine. He would like to have communications from his colleagues in the United States and reprints sent to that address.

THE officers charged with the arrangements for the tenth International Ornithological Congress, which was to have been held in the United States in 1942,

announce that the proposed meeting has been indefinitely postponed.

THE autumn meeting of the American Electrochemical Society will be held in Chicago from October 1 to 4, under the presidency of Raymond Ridgway, of the Norton Company, Chippawa, Ontario, Canada.

A MEETING of teachers of astronomy will be held at the Yerkes Observatory on Sunday, September 7, at 2:30 P.M. There will be an exhibit of astronomical texts, elementary and advanced, popular books on astronomy, periodicals, laboratory notes and equipment, diagrams, charts and lantern slides. Those who wish to exhibit material should send it to Yerkes Observatory, Williams Bay, Wis., in care of Dr. Jesse Greenstein. Questions concerning possible exhibits should be addressed to him or to John H. Pitman, Swarthmore College, Swarthmore, Pa.

THE third annual meeting of the Midwest Academy of Sciences of Kansas City, Mo., was held at the Junior College Building from June 26 to 28, under the presidency of Dr. J. L. Jones. The academy is divided into sections: Geology, Psychology, Sociology, Languages, Medicine and Health and Churches, Missions and Welfare. There were two general sessions, the first on the evening of June 26, when addresses were given by A. C. Carpenter, Arthur Bridwell and H. Pyle, after which Dr. J. L. Jones gave his presidential address, which was entitled "The Poisonous Snakes and Insects of this Region." The second general session on the following evening was devoted to the general sciences and to law. The opening was announced of a small laboratory at the Institute of Sciences, to be known as the "Edward J. Petry Biological Laboratory." The late Dr. Petry, who was professor of botany at Coe College, Cedar Rapids, Iowa, had frequently lectured at the Junior College. Mrs. Dora Petry, who was present, presented gifts to the laboratory from Dr. Petry's laboratory and library.

THE program of Advanced Instruction and Research in Mechanics now being carried on at Brown University in a twelve-week session will be continued throughout the academic year 1941-42. An expert faculty is being engaged and the courses (four in number plus two seminars) will each semester parallel to some extent those given in the summer. The work is planned so that participants can profit by one, two or three terms. The number of persons who can be accepted is less than the 60 who are registered for the Summer Session, and already a considerable number have applied for admission. Because of the subventions, there will be no charges for tuition in any of the courses; this remission is the equivalent of a

scholarship of several hundred dollars for each of the semesters. In addition, students will be eligible to apply for fellowships ranging in size up to \$600 for the year. Information may be obtained from the Dean of the Graduate School.

ACCORDING to the report of the Alfred P. Sloan Foundation for the year 1940, grants authorized by the foundation during the year included the sum of \$338,221 for some phase of American economic education and research. The recipients of grants were New York University, \$55,085; the University of Denver, \$51,988; Stephens College, \$47,350; the University of Chicago, \$46,718; Affairs Committee, \$44,946; Massachusetts Institute of Technology, \$32,500; Brookings Institution, \$25,000, and the University of Pennsylvania, \$15,455.

THE *Journal* of the American Medical Association reports that under the will of George Herbert Jones, Chicago, one of the founders of the Inland Steel Company, about \$1,000,000 has been set aside to "promote scientific research to alleviate human suffering, improvement of living and working conditions, improvement of facilities for recreation, and improvement of hygiene and prevention of disease, and to assist care of children, the sick, aged, and helpless; reformations of victims of alcohol and narcotics, ex-convicts and wayward persons, and to facilitate work in social and domestic hygiene." The will directs that the income and not more than 10 per cent. of the principal are to be disbursed by the Chicago Community Trust to charities and educational institutions which "best make for the mental, moral, intellectual and physical improvement" of residents of the state. Mr. Jones during his lifetime gave about \$4,000,000 to education and medicine.

STANFORD UNIVERSITY SCHOOL OF MEDICINE announces a series of Post Graduate Courses in Medicine, to be given from September 8 to 12 at the Stanford Medical School, in cooperation with the San Francisco Department of Health and the San Francisco Hospital. They include: Gynecology, Medical Diagnosis and Treatment, Diseases of the Genito-Urinary Tract, Diagnosis and Treatment of Malignant Tumors, Cardiovascular Diseases, Surgical Anatomy and Operative Technic, Surgical Emergencies, Traumatic Injuries and Fractures, Ophthalmology, and Anesthesiology. These courses are designed primarily for practicing physicians and are of the review or refresher type. Intensive instruction covering physiology, pathology, diagnostic procedures, as well as therapy, will be given by members of the faculty of the Medical School.

## DISCUSSION

## THE HIGH WAX CONTENT OF GREEN LINT COTTON

THE lint from *Gossypium hirsutum* (var. Arkansas green lint),<sup>1</sup> described by Ware,<sup>2</sup> differs from that of ordinary strains of upland cotton not only in its bright green color and soft feel to the touch but also in its remarkably high wax content. Whereas the wax content of most cotton lint varies within the range of from 0.4 to 0.7 per cent.<sup>3</sup> that of green lint cotton, based on the dry weight, has been found to vary within the high limits of from 14 to 17 per cent. This high wax content was discovered accidentally by the writer in connection with some inquiries into the source of different hues of fluorescence when cotton fiber was irradiated with ultraviolet light.

The wax may be removed readily from the lint of green lint cotton with hot ethyl alcohol, chloroform and other organic solvents. It is also quite soluble in hot acetic acid and cold pyridine. With alcohol as well as with most other solvents the hot extract is colored deep amber in transmitted light but fluoresces a deep velvety green in reflected light. However, the green color of the lint is not changed appreciably, if at all, by the extraction. Thus, it has not yet been ascertained whether the green fluorescence of the alcoholic extract is related to the green color of the lint or is entirely independent. When the hot alcoholic solution cools to 50–55° C. most of the wax separates out in poorly defined yellow crystalline flakes. Between crossed nicols the crystals are quite noticeably anisotropic.

By means of 95 per cent. ethyl alcohol and ethyl ether at room temperature it is possible to separate the crude wax into at least three fractions of different properties (Table 1):

TABLE 1

Fraction no.	Approx. per cent. of total	Solubility at room temperature	Melting point of solid °C.	Transmitted color of hot alcoholic solution	Velvety green fluorescence in reflected light
1	30	Moderate in alcohol	85–89	light green	inappreciable
2	50	Slight in alc., large in ether	86.5–90	golden brown	moderate
3	20	Slight in both alc. and ether	93–95	very dark brown	very strong

It seems quite likely that fraction 2 contains small amounts of the substance responsible for the dark color and deep velvety green fluorescence of fraction 3. The latter fraction is practically insoluble in ethyl ether,

<sup>1</sup> The samples were furnished by Dr. J. W. Neely through Dr. J. O. Ware, both of the Bureau of Plant Industry, U. S. Department of Agriculture.

<sup>2</sup> *Jour. Amer. Soc. Agron.*, 24: 550, 1932.

<sup>3</sup> *Shirley Institute Memoirs*, 4: 107–113, 1925.

even at boiling temperature and thus can be readily separated from the other two fractions. The very deep color of its solutions is not removed by wood or animal charcoal. A Salkowski test for phytosterol in this fraction was negative. All fractions have a remarkably high melting point compared with other naturally occurring waxes.

X-ray diffraction patterns show that a least a part of the wax occurs in a crystalline form in the fiber and is quite highly oriented, the most prominent diffraction arcs arising from crystal planes perpendicular to the fiber axis; this is the same as Berkley<sup>4</sup> found for the primary wall patterns of white upland varieties. The green lint cotton differs from the other varieties, however, in that a strong wax pattern persists even with the mature fiber.

Microscopic observation of the fibers in longitudinal mount or of their cross-sections does not reveal definitely the location of the wax. In cross-section an outer greenish translucent ring which constitutes one third to one fourth of the thickness of the wall may be observed on sharply focusing. When the fiber cross-sections are strongly swollen with cuprammonium solution a number of similar greenish translucent concentric rings may be seen throughout the wall. Thus far it has not been possible to identify any definite layer of the wall in which the waxy constituents may be considered to be concentrated.

A larger quantity of the wax has been collected for identification of the components.

CARL M. CONRAD

U. S. DEPARTMENT OF AGRICULTURE

POLIOMYELITIS IN A LABORATORY WORKER EXPOSED TO THE VIRUS<sup>1</sup>

ONE of our associates, a woman 35 years old, has developed paralytic poliomyelitis under circumstances which make it highly probable that the infection was contracted in the laboratory. The purpose of this preliminary report is to inform investigators, who may be engaged in work with poliomyelitis virus of human or recent human origin during the next two or three months, of the possibility of laboratory infection in order that they may take precautions which ordinarily might not have been observed. In the more than thirty years of experimental work on poliomyelitis there has not been a single instance of infection as a result of exposure to the virus in the laboratory. Since adults are relatively resistant and since most of the work has been done with rhesus monkeys and with monkey-adapted strains of virus, it is possible that the

<sup>4</sup> *Textile Research*, 9: 355–373, 1939.

<sup>1</sup> Aided by a grant from the National Foundation for Infantile Paralysis, Inc.

conditions were not especially conducive to laboratory infection. In recent years, however, an increasing number of investigators have turned to the study of the human disease and of the behavior of virus of recent human origin in chimpanzees and monkeys of species other than rhesus. It was during the course of work on cynomolgus monkeys which had developed poliomyelitis following the oral feeding of a strain of virus isolated from a child in 1940, that our associate, B. J., contracted poliomyelitis. We have discovered in recent weeks that in these monkeys readily demonstrable virus was present in the buccal, lingual, pharyngeal and intestinal tissues and contents, and B. J.'s duties included the washing and grinding of these tissues in preparation for inoculation into other monkeys.

The circumstances of the illness are as follows: B. J. was working with these infected tissues until June 14, when she left the laboratory to go on her vacation. On June 25, she first felt indisposed with slight headache and nausea. On June 27 and 28 she went to bed because of general malaise and severe backache. On June 29, partial paralysis of the right leg appeared. In the next few days the temperature varied between 102 and 104 degrees Fahrenheit, and there was extension of paralysis involving the entire right lower and upper extremities, the urinary bladder, part of the left lower extremity and partial ptosis and small pupil on the right side with transitory diplopia. Spinal puncture revealed 192 cells per cmm of cerebrospinal fluid. On July 3, the temperature returned to normal and no further progression of paralysis occurred. Virulent poliomyelitis virus was isolated from her on two occasions; first from a stool specimen obtained 24 hours after the onset of paralysis and the second time from the rectal and colonic washings, containing almost no solid matter, 3 days after the onset of paralysis. Extensive flaccid paralysis with typical histological changes in the spinal cord was produced in both cynomolgus monkeys and positive passage was obtained in each instance. The virus was not pathogenic for mice or guinea-pigs. It may be added that no outbreaks of poliomyelitis had been reported either in Cincinnati or the other places visited by her.

While other studies are still in progress, we believe that the balance of probability in this case is that the infection was contracted in the laboratory. Therefore, we wish to caution other investigators to observe the greatest care not only in handling tissues or excreta of human beings with poliomyelitis but also in working with monkeys (especially cynomolgi or related species) infected with virus of human or recent human origin. This may particularly apply when such virus is given by mouth or reaches the alimentary tract following nasal instillation, which is part of the

method now commonly used in testing for the virus in human stools.

ALBERT B. SABIN

ROBERT WARD

THE CHILDREN'S HOSPITAL RESEARCH  
FOUNDATION AND DEPARTMENT  
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# **ANOPHELES (KERTESZIA) BELLATOR D. & K., FOUND NATURALLY IN- FECTED WITH PLASMODIUM**

IN the cocoa-raising districts of Trinidad, *Anopheles bellator* is the most abundant *Anopheles* mosquito; it breeds in the epiphytic Bromeliads which grow in great numbers on the lofty immortal trees that shade the cocoa trees. The malaria rates in these areas are often high, and this mosquito has been suspected of being the vector. It is active during the twilight hours, and at that time attacks man in houses as well as out of doors. Unlike many other anthropophilous Anophelines, *A. bellator*, although it will enter houses and even bed-nets to feed on man, does not remain in houses after it has fed, but returns immediately to its resting places in the forests. Because of this habit, it is impossible to obtain freshly engorged specimens for determining the natural malarial infection rates among these insects; the females must be caught while they attack either the collector or another person being used as bait. Almost all the specimens captured by the authors appeared to be young females taking their first blood meals, but the 398th specimen dissected was infected with a single large oocyst, which ruptured as a result of slight pressure upon the coverslip, and liberated large numbers of motile sporozoites. The mosquito had been collected while it was attacking a native boy, near the Canadian Mission School on the St. Marie Immanuel Road, on July 11, 1941.

L. E. ROZEBOOM

L. A. FOX

R. L. LAIRD

# **THE PLACE OF MICROFILM COPYING IN LIBRARY ORGANIZATION**

THE recently perfected process of making photographic copies of printed pages upon moving picture film is the most economical method so far devised for rendering available to larger numbers of research workers the collections of source material contained in scientific periodicals. It is evident that microfilm copying constitutes a very real improvement and extension of library service and is destined to become an ever-increasing activity in the larger reference libraries. It is fitting, therefore, to discuss the basis upon which it should be undertaken in order to pro-

vide the greatest benefits to research and to the public welfare.

Practically all great reference libraries are maintained largely at public expense or by endowments which have been collected for educational or cultural purposes. Their doors are open freely to all who are able to use their resources for the advancement of science or learning. A reader in one of these libraries is provided usually with a comfortable working place and he is waited upon by a corps of highly trained employees who place at his disposal as many books and as much reference material as may be desired. The reader takes away in his head or in the form of notes such portions of the published material as he needs. There is no charge whatever and in only rare cases is any attempt made to estimate the cost of this part of library operation. This and each of its other functions is looked upon as a public service contributing to the welfare of mankind.

The question now arising in connection with microfilm copying is whether this should be considered in the same light as other services freely rendered by libraries or as something different for which a charge should be collected. Since microfilms are material objects which cost definite amounts to produce it will probably be assumed that they should not be given away like ordinary library service for which no accurate account of its cost can be kept.

Thus the first stumbling block to considering microfilm copying simply as an extension and perfection of library service arises from the circumstance that microfilms are material objects. The fact that the many intangible services rendered by libraries cost a great deal and are performed without charge is generally not considered. The point may also be made, that although the question of just how much service a library should render a reader seldom arises, there might be difficulty in deciding how many microfilms should be made gratis for each person. These are the kinds of problems which make it difficult to include

microfilm copying within the category of established library practice.

A question, however, of more fundamental importance for librarians to consider is whether the published reports in their periodical collections can be more efficiently and economically distributed to the many who are able to use them, by means of microfilms rather than by placing the books themselves at the disposal of the relatively few who can come to the library to consult them. It is also important to consider whether or not microfilm copying can be organized in such a manner that its cost will be no greater and possibly less than that required for lending books and maintaining the equipment and service necessary for library readers. In the opinion of those who have had experience with microfilm copying, this appears by no means beyond the realm of possibility. It is an objective worthy of the most serious effort.

Conditions have changed greatly in the organization and functions of reference libraries. The need of going to them to consult the literature has diminished greatly in the United States in recent years. Microfilms seem destined to hasten the day when it will no longer be necessary for any one to go to a reference library to satisfy his needs.

In conclusion the suggestion is made that publicly supported reference libraries eventually should perform microfilm copying for those engaged in research as freely as they now make interlibrary or other loans and provide facilities for consulting their books in their own reading rooms. Many other innovations in library practice were looked upon as dubiously in the beginning as the present suggestion may now be considered. It, however, offers such far-reaching advantages that its general adoption is certain to result in the ever-increasing contribution of libraries to the advancement of research and learning.

ATHERTON SEIDELL

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## SCIENTIFIC BOOKS

### ELECTROENCEPHALOGRAPHY

*Atlas of Electroencephalography.* By F. A. GIBBS and E. L. GIBBS. 221 pp.; 104 illustrations. Boston: privately printed. \$7.00. 1941.

THE "Atlas of Electroencephalography" by Frederick and Erna Gibbs appeared with a timeliness quite unintended by its authors. A few weeks after its publication the man to whom it is dedicated, Hans Berger, the father of electroencephalography, died. The atlas, with its dedication to Berger, will stand as a memorial to him. It will remind future electroencephalographers of the years of quiet, persevering

work that preceded Berger's original publication, the polite skepticism with which his work was greeted and its ultimate verification and general acceptance.

Berger has had no more devoted disciples than the Gibbses. From their first year as electrophysiologists in the reviewer's laboratory they have read with care and understanding Berger's long and sometimes difficult papers and have carried Berger's point of view and spirit over into their own work. As they state, the atlas maintains a single point of view, that of the neurologist. They could equally well have said "the point of view of Hans Berger." Theirs is the spirit of exploration and the effort to deduce

information of practical value in the understanding of normal and abnormal function of the human brain from the electrical changes that can be recorded from the surface of the scalp.

The variety of wave-form and pattern of the electroencephalogram must be presented graphically. Words alone are inadequate. In the atlas are hundreds of samples of records, thoughtfully and systematically selected, the digest of six years of experience with thousands of cases. Each record is accompanied by a brief but informative note on the case-history of the subject. Study and comparison are greatly facilitated by the fact that all the records were taken by the same (ink-writer) technique, under similar conditions, at the same speed of tape and usually at approximately the same amplification. All have been skilfully traced by hand and reproduced without reduction in size. The reader is not confused by immaterial and distracting technical differences and can concentrate his attention on the essential wave-forms and patterns. In a clear and simple text that occupies part of each left-hand page, the technique and the principles of electroencephalography are presented. The unity of presentation is further preserved by the omission of the Grass-Gibbs spectrum analysis. The authors are to be complimented on their restraint at this point, for valuable and interesting as the frequency-analysis is it would have been confusing to include it in this volume.

Particularly valuable is the long series of records from normal children. Instability, slow waves and irregularity that would be quite abnormal in an adult are perfectly normal in children, and although these differences were first pointed out by Berger and later elaborated by Smith and by Landsley there has nowhere been so complete a graphic presentation, side by side with records from normal adults.

The variety of records obtained in the convulsive states is equally valuable, including the presentation of questionably normal and even abnormal records from individuals who are and always have been normal as far as convulsions or epileptic conditions are concerned. The principles of localization of gross intracranial lesions are lucidly presented in considerable detail.

The atlas, in spite of its large size, twelve by fifteen inches, too large for any ordinary bookcase, is a "must" for every laboratory or clinic of electrophysiology and for every one who would be really informed on the subject. It is limited to human electroencephalograms, it is true; animal experimentation is represented only in the bibliography. But the bibliography of over six hundred titles is an achievement in its own right and will be of great use to students of the subject.

The text is admirable for its directness and clarity. Readers should appreciate that many of the statements are to be understood as first approximations or as general principles subject to secondary qualifications which are for the present omitted. Some may disagree, for example, with a sharp separation of epileptic patterns into three categories, the petit-mal, the grand-mal and the psychomotor. But the authors point out that the separation is schematic and that a patient may show now one and now another type or mixtures of any two or all three patterns. Perhaps the main fault of the book is its very clarity and simplicity of presentation. It makes electroencephalography look too easy and too much like a finished subject. The atlas should be regarded as a foundation and a starting-point—not as a final goal that has been achieved.

HALLOWELL DAVIS

DEPARTMENT OF PHYSIOLOGY,  
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## PSYCHOLOGY

*General Psychology.* By RAYMOND B. CATTELL. 624 pp. Cambridge, Mass : Sci-Art Publishers. \$3.50. 1941.

THE atmosphere of spirited discussion permeating this book should make it stimulating and provocative to students possessing the necessary command of basic factual material and terminology. While rather careless of details the author takes pains to present both sides of controversial questions, and his own conclusions appear to be fair and judicious. The present achievements of psychology he regards with a decidedly critical eye, but he is enthusiastic regarding the potentialities of this science. Even at present it has very considerable practical value. The applications to psychotherapy, education and industry are presented briefly but at sufficient length to carry some sense of their importance.

In his treatment of cognitive processes the author follows Spearman quite largely, while in the chapters on motivation he develops the ideas of McDougall and Freud with some attention also to Alfred Adler. This general topic with its ramifications is presented with relative fulness, occupying one third of the text. All motives and all behavior, the author believes, "spring from the need of satisfying a few pervasive and biologically indispensable drives." These "ergs," as he prefers to call them, control learning and acquired modifications to a great extent by making it naturally easier for the individual to learn some things than others. Much light on human motives and their conflicts and frustrations has been derived from the study of neurotic patients. Clinical experience affords pragmatic sanction to some at least of the

theories of psychoanalysis, but leaves to the experimental psychologist the duty of putting these theories to a laboratory test, so far as may be possible; and some such experimental work is being done. "All in all, the theories of the pioneers in clinical work give us broader horizons and indicate the probable shape

of the things to be investigated; but they can not provide us with a scientific foundation until other more statistical and experimental methods have confirmed them."

R. S. WOODWORTH

COLUMBIA UNIVERSITY

## SPECIAL ARTICLES

### CHIMPANZEE HANDEDNESS

Few reports have appeared on preferential hand usage in anthropoid apes; such data as have been presented have derived from scattered, largely non-experimental observations of a few animals. The present inquiry, utilizing 30 chimpanzees as subjects, is an attempt to determine if they use one or the other hand preferentially, how pronounced hand preference is in individual chimpanzees, and how right- and left-handedness is distributed in these animals.

Four test situations, demanding fairly precise, skillful manipulations and designed to preclude the subjects' procuring incentive in any way other than with one hand, were set up. All subjects were tested in their outdoor living cages; each was isolated while being tested. Manipulation (procuring pieces of fruit) was performed by the subjects through the 2-inch square apertures of their wire-netting cage-walls (diagonals of apertures were horizontal and vertical). Test situations were: (A) One end of each of 10 parallel strings, each 6 inches long, spaced at 3-inch intervals, was attached 1 inch from the edge of a board 30 inches square; with the strings stretched out on the board and perpendicular to edge of attachment, pieces of fruit were attached to the free ends of the strings; the edge of the board was placed against the cage-wall; hand used by subject in pulling- or raking-in each piece of fruit was tabulated; in this (and in the other situations) the board was quickly withdrawn if subject attempted to procure incentive in any way other than with one hand (such as with lips, feet or both hands); (B) 10 small pieces of fruit, spaced at 3-inch intervals and 1 inch from edge of board, were presented; (C) small pieces of fruit were placed individually under a small metal box which was hinged at end away from subject; subject procured incentive by reaching through a rectangular hole (1½ inches wide, 2 inches high) in a piece of ½-inch plywood and upsetting metal box; hand so used was scored "preferred"; and (D) pieces of fruit were presented individually on a board 1 inch from cage-netting. Situation A was presented until subject had procured 100 pieces of fruit, then Situation B until subject had procured 100 pieces of fruit, and so on in the sequence A-B-C-D-D-C-B-A. Thus, for each subject, hand used was tabulated for 800

manipulations. Subjects were given 100 trials in a single session in one day, were not tested on immediately succeeding days.

Of the 30 chimpanzees tested, there were 22 adult females, 4 adult males (Bokar, Frank, Jack, Pan), 2 adolescent females (Beta, Gamma), 1 five-year-old female (Dina), and 1 three-year-old male (Fin).

Fig. 1, a bar diagram, shows the distribution of right hand use among the subjects for the combined trials of all situations (i.e., the number of times in 800 trials each subject used right hand).

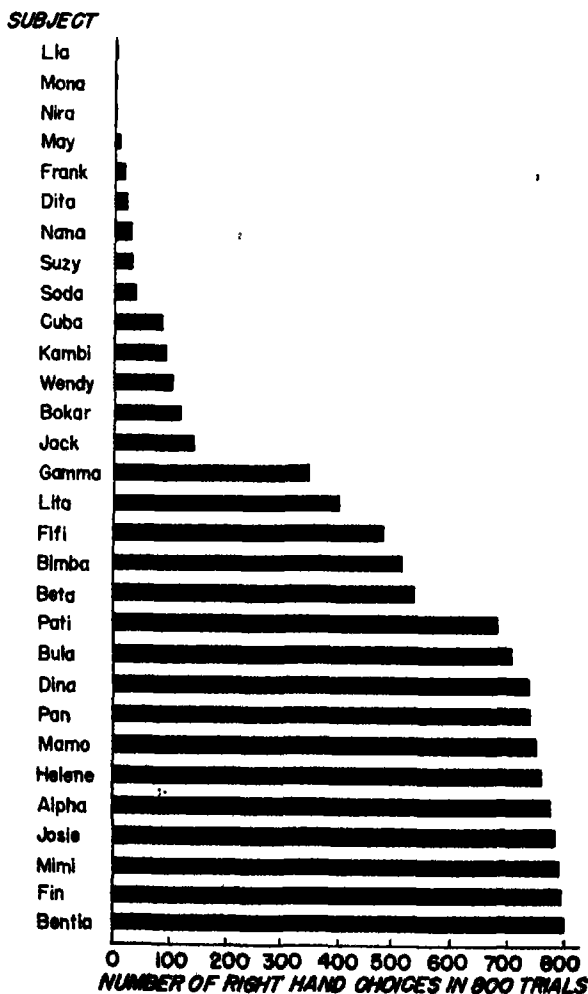


FIG. 1

From this figure, it will be seen that 18 of the 30 subjects used one hand (9 used right; 9, left) in more than 90 per cent. (720) of the 800 trials, and that 25 used one hand (11 used right; 14, left) in more than 80 per cent. (640) of the 800 trials. Examination of the protocols of the 5 animals (Gamma, Lita, Fifi, Bimba, Beta) who exhibited least-pronounced unilateral preference, shows that their detected low-handedness scores are largely attributable to low inter-test agreement, although low single-test reliability also contributes to their attenuation.

Admittedly, increasing the number of test-situations should result in a more adequate determination of chimpanzee handedness; however, the present work does not pretend to explore more than a rather narrowly limited aspect of chimpanzee lateral organization. So far as test-reliability is concerned, precise mathematical statement is difficult because of the bimodality of the distributions involved; test-retest scores of Situations C and D each show handedness shifts for one subject, A for 5, B for 6 subjects (i.e., subjects used one hand for more than 50 of the first 100 trials of a given situation, the same hand for fewer than 50 of the second 100 trials of the same situation). Twenty animals gave no such inversions, 7 gave only one each, while the other 3 animals each gave two inversions.

**Summary:** (1) Of 30 chimpanzees tested, 25 exhibited marked handedness. (2) Detected right- and left-handedness were almost equally distributed in the group of animals. (3) Each of 9 chimpanzees used right hand, 9 used left hand, in more than 90 per cent. (720) of 800 trials (4 test-situations); each of 11 chimpanzees used right hand, 14 used left hand, in more than 80 per cent. (640) of 800 trials.

GLEN FINCH

YALE LABORATORIES OF PRIMATE BIOLOGY

#### CHANGE FROM SELF-INCOMPATIBILITY TO SELF-COMPATIBILITY ACCOMPANYING CHANGE FROM DIPLOID TO TETRAPLOIDY

It has very recently been determined for fifteen different self-incompatible plants of *Petunia axillaris* (Lam.) B. S. P. (*P. nyctaginifolia* Juss.) that the change from a diploid condition ( $2n=14$  chromosomes) to a tetraploid condition ( $4n=28$  chromosomes) was accompanied by a change to self-compatibility in fertilization and seed formation.

These plants were grown from seeds. By treatment with solutions of colchicine from one to three tetraploid branches were obtained on each plant while the other branches remained diploid. The flowers on the tetraploid branches were somewhat larger

than those on the diploid branches and their pollen grains were larger and many had four germinal pores instead of three. The diploid and the tetraploid conditions were verified for several of the plants by counts of the chromosomes in pollen mother cells during stages of the reduction divisions.

For all these plants the results of controlled and proper pollinations demonstrated that the normal and potentially highly fertile flowers of the diploid branches were self-incompatible and produced no seeds or even rudimentary capsules to normal self-pollination but that the self-pollinated flowers of tetraploid branches on the same plants produced extra large capsules that were well filled with seeds.

Pistils of flowers on the self-incompatible diploid branches developed into capsules with many seeds when pollinated from flowers of tetraploid branches on the same plant. But all tests thus far made for tetraploid  $\times$  diploid combinations on the same plant have failed to yield any seeds. Also unpollinated pistils of emasculated flowers set no seed either on diploid or on tetraploid branches.

Numerous studies in recent years have demonstrated that the physiological reactions of both self-incompatibility and cross-incompatibility within many species of homomorphic flowering plants are correlated with, and determined by, special hereditary factors and that incompatible reactions involve genetic similarity in respect to special factors or combinations of them.

For the fifteen plants here reported each is self-incompatible in its diploid branches. In the cells of the tetraploid branches on each of these plants there is a duplication of the chromosomes and also, presumably, of the genetic factors which produce self-incompatibility. But this duplication results in a reversal in the reactions of fertilization, and at least one, if not more, of the classes of pollen that segregate from the tetraploid complex is able to function in the production of seed after self-pollination.

A. B. STOUT

CLYDE CHANDLER

THE NEW YORK BOTANICAL GARDEN

#### THE PHOTOCHEMICAL SPECTRUM OF CYTOCHROME OXIDASE IN HEART MUSCLE<sup>1</sup>

THE respiratory ferment of yeast and acetic acid bacteria has been shown by Warburg and his associates<sup>2</sup> to exhibit a photochemical absorption spectrum

<sup>1</sup> This work was carried out by the author during the tenure of a Finney-Howell Research Foundation Fellowship (1939-41). It was aided by a grant made to Dr. Kurt G. Stern by the Jane Coffin Childs Memorial Fund for Medical Research.

<sup>2</sup> O. Warburg and E. Negelein, *Biochem. Zeitschr.*, **214**: 44, 1929. F. Kubewitz and E. Haas, *ibid.*, **258**: 247, 1932.

typical for pheohemin proteins. The values obtained by these workers<sup>3</sup> for rat retina represent points on the spectrum of the Pasteur enzyme (Stern and Melnick<sup>4</sup>). The respiratory ferment in animal tissues is generally identified with cytochrome oxidase, which catalyzes the oxidation of cytochrome c.

For an investigation of the spectrum of cytochrome oxidase in mammalian tissue, phosphate extracts (pH 7.3) of rat heart muscle were chosen; succinate served as substrate. The extracts contained an excess of cytochrome c. Although the overall reaction is the oxidation of succinate to fumarate, there is ample evidence to show that this reaction is mediated by the cytochrome-cytochrome oxidase system.<sup>5</sup> CO is a strong inhibitor of cytochrome oxidase in the absence of cells<sup>6</sup>; this inhibition may be relieved by light. Such extracts exhibit a vigorous O<sub>2</sub> uptake in the presence of succinate at temperatures as low as 10°, and consequently lend themselves to the photochemical technique.

The arrangement of the photochemical apparatus and the method of charting photochemical absorption spectra have already been described.<sup>2,4</sup> In the present case the photochemical effect consists of an increase in O<sub>2</sub> uptake when rat heart muscle extract, in the presence of succinate and a gas phase of 95 per cent. CO and 5 per cent. O<sub>2</sub>, is subjected to strong monochromatic illumination. The relative light absorption coefficients as referred to a standard wave-length

( $\beta\lambda/\beta_{430}$ ) were calculated for twenty-three wavelengths.

The data show that cytochrome oxidase from a mammalian source, like the respiratory ferment in yeast and in bacteria, exhibits a spectrum characteristic of pheohemin compounds. There is a steep Soret or  $\gamma$ -band in the blue at 450 m $\mu$ , and two secondary maxima, the  $\beta$ -band in the blue-green at 510 m $\mu$  and the  $\alpha$ -band in the yellow at 589 m $\mu$ . The thermolability of the enzyme suggests that the hemin grouping is combined with a protein. In spite of the similarity of the spectral patterns of these enzymes, there exist significant differences in details, indicating that they are not identical. Thus the position of the main absorption band is at 450 m $\mu$  in the instance of the enzyme of heart muscle and at 430 m $\mu$  for that in acetic acid bacteria and in yeast.<sup>2,7</sup>

It is of interest to note that the Pasteur enzyme of rat retina also has its main absorption band at 450 m $\mu$ <sup>4</sup>; however, its non-identity with rat heart muscle cytochrome oxidase is indicated by the fact that the  $\alpha$ -bands are located at different positions, namely, at 578 m $\mu$  for the Pasteur enzyme and at 589 m $\mu$  for cytochrome oxidase. A similar situation exists in the yeast cell where the  $\gamma$ -bands of the Pasteur enzyme and the respiratory ferment coincide, whereas the structure of the  $\alpha$ -bands differs significantly.<sup>7</sup>

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## SCIENTIFIC APPARATUS AND LABORATORY METHODS

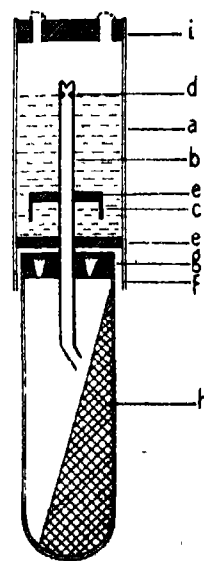
### THE EXAMINATION OF CONTAMINATED WATERS<sup>1</sup>

A RAPID method has been devised to speed up the routine bacteriological examination of water from an average of 48 to 96 hours to 8 to 10 hours. The sample is inoculated into routine presumptive lactose broth, then transferred at the optimum time to a confirmation media, either liquid or solid. No difficulty has been experienced in obtaining discrete colonies. The ordinary laboratory glassware is used to assemble this very simple apparatus. Both presumptive and confirmation media can be sterilized and handled as a single unit. Other types have been developed for special purposes.

The principle of this method is the utilization of gas produced by fermentation in the presumptive media to cause a small amount of enriched inoculum to overflow into a conductor tube, automatically inoculating the

Fig. 1

- "a" Presumptive tube containing Lactose Broth.
- "b" Conductor tube.
- "c" Fermentation vial.
- "d" Limiting level mark; = height of water + media.
- "e" One hole rubber stoppers.
- "f" Glass skirt; continuation of presumptive tube.
- "g" Rubber stopper notched along edge to admit air.
- "h" Confirmation media; solid E.M.B. slant, or liquid B.G.B.
- "i" Two-hole rubber stopper with cotton plugs.



<sup>1</sup> O. Warburg and E. Negelein, *ibid.*, 214: 101, 1929.

<sup>2</sup> E. G. Stern and J. L. Melnick, *Jour. Biol. Chem.*, 139: 301, 1941.

<sup>3</sup> D. Kellin and E. F. Hartree, *Proc. Roy. Soc. Series B*, 127: 167, 1939.

<sup>4</sup> *Ibid.*, 125: 171, 1938.

<sup>5</sup> J. L. Melnick, *Proc. Am. Soc. Biol. Chem.*, 35th Annual Meeting, 1941, p. 90.

<sup>7</sup> Preliminary report.

confirmation media. It should be understood that since the success of this method depends upon the formation of certain minimum amounts of gas those samples having very few organisms, or predominatingly slow lactose fermenters, must necessarily take a longer period of time for completion of the test. Speed is enhanced by using larger samples for only slightly contaminated waters.

The governing factors are: (1) concentration of organisms in inoculum; (2) size of fermentation vial which regulates the amount of liquid which will overflow into conductor tube; (3) height of limiting level mark; (4) diameter and shape of conductor tube; (5) length of time inoculum is enriched before passing into conductor tube, 4 hours found to be optimum time. All these factors are controllable.

With this method, mobile laboratories are enabled to collect a flock of samples on one day and are ready to move again the next morning when the tests are completed. Positive tests on ships' supplies may be accomplished overnight as compared with 48 to 96 hours. In a large distribution system, water leaving the reservoirs may be tested with ensuing results obtained sufficiently early to regulate the supply before it reaches the end of the distribution system.

HAROLD LEON FRUITMAN

SAN FRANCISCO WATER DEPARTMENT

#### PERMANENT MOUNTS OF VIRUS-INFECTED CHORIOALLANTOIC MEMBRANES

THE chorioallantoic membrane of chick embryos has become an important tissue for the cultivation of viruses. The lesions produced are in many cases characteristic of the infecting virus. There is a need for an easy method of permanently mounting such membranes. A method is here described which has proven itself to be satisfactory.

The mounting material is prepared by slowly pouring, with constant stirring, 50 gm of powdered isobutyl methacrylate polymer<sup>1</sup> into 100 cc of xylol. The mixture is placed in the incubator and stirred at intervals until it becomes clear. This takes about an hour. A higher concentration of the plastic is less good, as air bubbles do not rise well to the surface.

The membranes are harvested in the usual manner and rinsed in physiological saline or Tyrode's solution. They are then passed through a series of dilutions of ethyl alcohol, 5, 10, 15, 20, 25, 30, 40, 50, 65, 85, 95 per cent. and, finally, absolute alcohol. They are spread out and left in each dilution for 15 minutes or longer, except for the absolute alcohol in which they are left for at least half an hour. Just before mounting they are transferred from the latter to xylol, where they are left for five minutes. About 5 cc of

the solution of plastic is poured into the bottom of a Petri dish. The membranes are drained slightly and spread out in this. A paper label may be embedded beside them. This may be typewritten or marked with pencil, ink or india ink. The Petri dish is set aside to dry in a dust-free place. A second layer of plastic is added to cover all irregularities. When this has hardened, the cover of the Petri dish is put on to protect the surface from dust and injury.

When the membranes are passed through fewer dilutions of alcohol or more rapidly, the normal parts do not remain as clear and the lesions do not show as well. Other solvents were tried, but none gave better results than xylol.

No difficulty is experienced from curling of the membranes. In membranes with considerable edema there is a shrinkage of 10 to 15 per cent, but in normal ones or in those with little edema there is no shrinkage.

This method produces a solid mount which can be easily handled and examined. The areas of hyperplasia due to virus infection stand out in sharp contrast to the surrounding tissue.<sup>2</sup>

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<sup>2</sup> I wish to express my appreciation for the valuable suggestions of Dr. Maurice N. Richter. This work was conducted under a grant for virus research from the Lambert Pharmacal Company, St. Louis, Mo.

#### CORRECTION

IN Table 2 of the article "Prevention of Tumor Growth (Carcinoma 2163) by Intravenous Injections of Yeast and Vitamins" (SCIENCE, July 18, 1941) the per cent. figures for non-takes should read: Yeast + Riboflavin 62%, Yeast 21%, Riboflavin 14%, Yeast + Thiamin 18%, Thiamin 3%.

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<sup>1</sup> Manufactured by E. I. du Pont de Nemours and Company, Wilmington, Del.

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## THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

### THE PASADENA MEETING OF THE PACIFIC DIVISION

Edited by Professor J. MURRAY LUCK

SECRETARY

DURING the week of June 16, 1941, the twenty-fifth annual meeting of the Pacific Division, American Association for the Advancement of Science, and of eighteen associated societies was held at Pasadena, California. The meetings extended over six days.

In two respects at least they are to be regarded as the most eventful in the history of the division. The attendance far exceeded that of any previous meeting, the total number of members and guests who registered being 1,314. There is good reason for believing that many were in attendance at the meetings who failed to register. At the previous meeting in Pasadena (1931) which was national in character, the total registration for the week was 1,193. It is a

matter of interest and at the same time a matter of regret to scientists on the Pacific Coast that these meetings failed to enjoy the attendance and participation of any appreciable number from the East. For example, 1,142 of those who attended the present meeting were from California, and only 82 were from outside the territory of the Pacific Division proper. The meeting was also eventful in that it represents a turning point in the history of the division—the completion of the first quarter-century of organized activity on the part of scientific societies in the Pacific states.

It was inevitable that the complexion of the meetings should be colored somewhat by the troubled con-

ditions existing abroad and the grave emergency that confronts the nation. That the conditions of the day are such as to throw upon organized science an added burden of responsibility is reflected in various contributions to the meetings proper. Most noteworthy in this respect was the divisional symposium on "Science and National Defense," in which papers were contributed by Professor M. P. O'Brien, of the University of California, Dr. Karl F. Meyer, of the Hooper Foundation for Medical Research, and Dr. Arthur G. Coons, of Claremont Colleges. The topics were "The Relation of the Engineering Colleges to the National Defense Program," "Medical and Public Health Problems in Relation to National Defense" and "The Economics of National Defense," respectively.

The afternoon of the same day was devoted to surveys of current research, a program which has been repeated annually by the Pacific Division for many years. Dr. W. S. Adams, Mount Wilson Observatory, reviewed some of the "New Results in Stellar Spectroscopy"; Professor E. W. Schultz, of Stanford University, discussed some of the outstanding "Recent Advances in the Study of Poliomyelitis"; Julian Hinds, of the Metropolitan Water District of Southern California, gave an interesting survey of some of the engineering problems encountered in the construction of the Metropolitan Aqueduct; and Dr. Myron Prinzmetal, of the University of Southern California, presented a résumé of "Recent Studies on High Blood Pressure."

The evenings of Tuesday, Wednesday and Thursday were devoted to addresses of general interest to visiting members, as well as to the lay public. That of Tuesday evening was delivered by Professor H. U. Sverdrup, president of the Pacific Division, who spoke on "The Pacific Ocean." On Wednesday evening Professor Max Mason, of the California Institute of Technology, discussed the progress of work on the 200-inch telescope, an instrument which is an increasing source of interest to visitors at the institute. The concluding address was given by Dr. John H. Lawrence, of the University of California, on "Biological Studies with Radioactive Elements."

Several events of a social character, arranged for the entertainment of visiting members and guests, completed the general sessions of the division. Deserving of special mention was the reception tendered by the Huntington Library and Art Gallery on the afternoon of June 16. A special exhibit of Aeronautica, historical in character, and arranged by the staff of the Huntington Library, proved to be of outstanding interest. In addition to more than 1,500 printed items, the library's Aeronautica collection is rich in engravings, drawings, cartoons and other pictorial items.

On Wednesday afternoon tea was served in the patio of the Athenaeum to approximately 300 of the members in attendance, while on Thursday afternoon many took advantage of an opportunity to visit some of the beautiful private gardens in Pasadena.

Meetings of the executive committee of the council were held in the course of the week. Professor D. R. Hoagland, of the Division of Plant Nutrition, University of California, was elected to the presidency of the division for the ensuing year, and A. R. Moore, of Oregon State College, Corvallis, was elected a member of the executive committee in succession to Paul W. Merrill, who retires on completion of his term of office. T. I. Storer and Linus Pauling were elected to the council as members-at-large, for four-year terms.

Announcement was made that the meetings of 1942 and 1943 will be held in Salt Lake City, Utah, and Corvallis, Oregon, respectively.

Local arrangements for the meeting were in the care of a committee consisting of Paul W. Merrill, *chairman*; William R. Smythe, *vice-chairman*; Alice Beach, *secretary*; Ian Campbell; Philip S. Fogg; William V. Houston; F. W. Maxstadt; William W. Michael; Robert A. Millikan; Robert O. Schad; Franklin Thomas; J. Paul Youtz.

Publicity and press relations were under the immediate supervision of Professor William Huse, of the California Institute of Technology.

Three institutions, assisted by the Pasadena Chamber of Commerce, served jointly as hosts for the meeting: The California Institute of Technology, the Henry E. Huntington Library and Art Gallery and the Mount Wilson Observatory.

Perhaps there is no satisfactory way of measuring the "success" of scientific meetings, but it is perhaps fair to say that, in the judgment of many, the meetings were outstanding. Quite apart from the unusually heavy registration, the sessions of individual societies were exceptionally well attended and many papers of outstanding merit were presented. Some of the symposia organized by individual societies were of singular merit and evoked wide-spread interest and participation on the part of the members.

All the meetings were held on the campus of the California Institute of Technology, which provided excellent facilities for the participating societies. Numerous exhibits arranged by departments of the institute proved to be of great interest to visiting members and guests.

It is hardly possible within the limits of available space to describe adequately excursions to points of interest in the immediate vicinity, but mention should be made of the Hale Solar Laboratory of the Mount Wilson Observatory, which was open daily, and of the special trip to Mount Wilson arranged for visitors on Friday afternoon.

## SESSIONS OF AFFILIATED SOCIETIES

Eighteen of the affiliated and associated societies participated in the meetings and over five hundred papers were presented. The reports of the various sessions follow:

AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS  
PACIFIC SLOPE BRANCH

(Report by Roy E. Campbell)

The 20th annual meeting of the Pacific Slope Branch was highly successful. Of the total of 57 papers listed on the program, only 3 authors were absent. The total attendance was 335. Each session was started with an invitational paper of special interest, among which were: "Commodity Treatment for the Alleviation of Plant Quarantine," by D. B. Mackie; "Some Problems of Western Forest Entomology," by K. A. Salman; and "Radioactive Elements in Entomological Research," by R. Craig.

Wednesday sessions were devoted to reports of experimental work on vegetable, sugar-beet and garden insects, parasites and fumigation. There was a session on Wednesday night on "Systematic Entomology" arranged by E. O. Essig, in which this subject was thoroughly discussed by Professor Essig, H. H. Keifer, E. G. Linsley, M. T. James, G. F. Ferris and R. L. Usinger. The interest in this subject was shown by the fact that there were 145 in attendance.

The outstanding session was on Thursday, devoted to a symposium on "Petroleum Oil Sprays on Deciduous and Citrus Fruit Trees." All papers and discussions were by invitation. W. M. Hoskins discussed "Some Recent Advances in the Chemistry and Physics of Spray Oils and Emulsions," and A. W. Cressman presented "Methods of Determining Oil Deposit." E. L. Overholser discussed "Physiological and Physical Effects of Spray Oil on Deciduous Trees." "Effects of Petroleum Oil Sprays on Citrus Trees" was given by P. W. Rohrbaugh, and "Effects on Quality of Citrus Fruits" by W. B. Sinclair. The use of toxicants in oils was discussed by several speakers.

On Thursday night a very successful dinner was given at the Altadena Country Club, with an attendance of 278.

The Friday morning program, devoted to "Problems in Western Forest Entomology," was ably arranged by K. A. Salman, and several interesting papers were given by members of the staff of the Forest Insect Laboratory at Berkeley on various western forest insects. On Friday afternoon the sessions were concluded with miscellaneous papers, including some on the honeybee, thrips, properties of insecticidal dust and a colored motion picture called "Louse Control."

The officers elected for the ensuing year were:

Chairman, George F. Knowlton, Logan, Utah; Vice-Chairman, Jas. C. Evenden, Coeur d'Alene, Idaho; Secretary-Treasurer, Roy E. Campbell, Alhambra, California.

## AMERICAN ASSOCIATION OF PHYSICS TEACHERS

(Report by E. C. Watson)

The program of the American Association of Physics Teachers consisted of a session devoted to contributed papers and a session devoted to invited papers. Speakers ranged from Tucson, Arizona, to Seattle, Washington, but were mostly from Southern California. The attendance totaled more than 80 and fell at no time below 50. Twelve states in all were represented.

Twelve papers only were presented and so ample time was available both for adequate presentation and for discussion. Three of the papers dealt specifically with problems in the teaching of physics, three with the history and philosophy of physics, and two were accompanied by experiments or demonstrations. Discussion centered principally around Professor V. F. Lenzen's paper on "The Meaning of Dimensions" and Professor R. W. Kenworthy's paper on "Concepts of Potential Difference and Electromotive Force as Presented in College Physics Texts." Unfortunately, Professor T. von Karman was called to Washington on national defense work and so was unable to present his paper on "Aerodynamics in College Physics."

AMERICAN CHEMICAL SOCIETY,  
PACIFIC INTERSECTIONAL DIVISION

(Report by Carl Niemann)

The meetings of the Pacific Intersectional Division of the American Chemical Society were well attended and sixty-two papers were presented during six half-day sessions. One session was devoted to papers in the field of synthetic organic chemistry and among the subjects considered were: the structure of naphthenic acids, the reaction of the Grignard reagent with lactones, syntheses in the cyclobutane series, the synthesis of alkoxyacetylenes, the synthesis of "ortho" thyroxine and the constitution of arabogalactan. The mechanism of some organic reactions provided papers for a second session and the titles presented dealt principally with the hydration of ethylenic double bonds, cis-trans isomerization of ethylenic double bonds and cyanohydrin formation. In the third session allotted to organic chemistry, papers which considered some of the reactions of hemoglobin, myosin, pituitary lactogenic hormone, glutathione and chlorophyll were read. In addition to the above there were interesting accounts of researches on the provitamin-A content of American whole-wheat flour, the non-enzymatic darkening of fruits and the digestibility of proteins.

The remaining three sessions were allotted to papers in the field of physical and inorganic chemistry. In the first session of this group a number of papers on the molecular structure of some organic and inorganic compounds were given and in addition one paper described the use of punched cards in calculations of molecular structure. A second session was devoted to the presentation of papers dealing with radioactivity and thermochemistry and among the topics considered were: fission products from uranium 238, chemistry of radio hydrogen (tritium), the heat capacity of gaseous paraffin hydrocarbons, the entropy of methyl mercaptan and the thermal decomposition of dimethyl acetal. The final session was devoted to the consideration of such papers as the quantitative stability relationship between the various forms of silica, the mercurous bromide electrode, the dissociation of salts in solvents of low dielectric constant and the use of phase diagrams in the classification of liquid crystalline phases.

In addition to the above a number of laboratory demonstrations were arranged in both physical and organic chemistry and the meeting was concluded with a joint dinner with the Southern California section of the American Chemical Society.

#### AMERICAN METEOROLOGICAL SOCIETY

(Report by G. M. Sheldon, Jr.)

The Pasadena meeting of the American Meteorological Society, held in conjunction with the meeting of the Pacific Division of the A.A.A.S., was well attended and all the seventeen papers presented, during the four half-day sessions, were of exceptional interest. The meeting was closed with a luncheon Friday noon, after which was shown a motion picture in color on "Cold Front Phenomena."

The largest group at any one session was the approximately two hundred who attended the symposium on long-range forecasts on Thursday afternoon. The papers covering the theory and research and the preparation of the forecasts, given by Dr. Krick, and the verification and results, given by Mr. Elliott, brought forth considerable comment and discussion.

The papers presented covered four general fields of research, namely, radiation and fogs, illumination climate, long-range forecasts and convective showers and thunderstorms.

The officers of the Los Angeles Seminar for the coming year were introduced: *Chairman*, Dr. J. Bjerknes, University of California at Los Angeles; *Vice-Chairman*, Kenneth Fink, of the U. S. Weather Bureau at Los Angeles; *Secretary-Treasurer*, D. C. Tandy, of the American Airlines, Inc., at Burbank.

#### AMERICAN PHYSICAL SOCIETY

(Report by Paul Kirkpatrick)

Sessions for the presentation of brief contributed research reports were held on Wednesday, Thursday and Friday forenoons. These reports, thirty-five in number, touched upon theoretical and experimental investigations in varied fields, with purely theoretical papers concentrated in the Wednesday morning program. Diverse topics were grouped in the Thursday program, while Friday's session consisted of x-ray and spectroscopic contributions.

Two symposia concerned with applications of physics in adjacent fields were presented at the Wednesday and Thursday afternoon sessions. On Wednesday the society met in joint symposium with the Astronomical Society of the Pacific to consider dynamical phenomena of atmospheres in general and specifically that of the sun, earth and other planets. Papers by J. Holmboe, J. Strong, F. C. Slipher and S. B. Nicholson were heard. The symposium of Thursday afternoon upon electron microscopes was addressed by Otto Beeck, Alfred Marshak and William V. Houston. Many industrial, biological and chemical applications, projected and accomplished, were presented. A motion picture of the RCA electron microscope was shown. Following the symposium the audience was invited to witness Professor Houston's two-stage electron microscope in operation.

On Wednesday evening a joint dinner was held with the Astronomical Society of the Pacific; and at a physics luncheon on Thursday the group was addressed by President George B. Pegram, of the American Physical Society.

#### AMERICAN PHYTOPATHOLOGICAL SOCIETY, PACIFIC DIVISION

(Report by C. E. Yarwood)

The society held four half-day sessions for submitted papers; a symposium, with certain other societies, on "Micronutrient Deficiency Diseases of Crops," under the chairmanship of D. R. Hoagland; an evening dinner meeting with entertainment provided by the membership; and a field trip under the direction of K. F. Baker. Of the twenty-nine volunteered papers, twelve were on virus diseases, nine on fungous diseases, five on plant disease control, two on diseases caused by nematodes and one on non-parasitic diseases. Among the more outstanding papers were one by M. B. Linford on the mechanism of feeding of nematodes, one by D. E. Bliss on artificial inoculation of plants with *Armillaria mellea*, one by L. C. Cochran and L. M. Hutchins on a wide-spread ring spot virosis on various species of *Prunus* and one by W.

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AMERICAN SOCIETY FOR HORTICULTURAL SCIENCE,  
WESTERN SECTION

(Report by W. W. Aldrich)

This was the third annual meeting of the Western Section. The program included a joint symposium, five half-day sessions for the forty-one submitted papers, including one joint session with the Western Section of American Society of Plant Physiologists, the annual dinner and a tour of the U. S. Regional Salinity Laboratory and the Citrus Experiment Station, at Riverside.

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the ten papers on Friday morning, one showed the effect of organic matter in increasing water penetration, two reported methods of studying soil moisture depletion by citrus, four were upon delayed foliation and one upon relative resistance to powdery mildew by delphinium species. These sessions had an average attendance of fifty-three.

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Officers for the coming year, elected at the dinner on Friday evening, are: *Chairman*, A. C. Hildreth; *Vice-Chairman*, F. M. Coe, and *Secretary-Treasurer*, J. H. MacGillivray.

AMERICAN SOCIETY OF ICHTHYOLOGISTS AND HERPETOLOGISTS, WESTERN DIVISION

(Report by Richard S. Croker)

The meetings of the Western Division, American Society of Ichthyologists and Herpetologists, were featured by three symposia and a half-day session of general papers. The first symposium was on introduced fishes in the waters of the Pacific Coast. Papers were presented by Brian Curtis, W. A. Dill, W. M. Chapman, G. H. Clark, and P. R. Needham and Osgood Smith. The consensus of opinion expressed was that the introduction of exotic fishes had been a worthwhile success. The symposium on rattlesnakes and other pit vipers featured papers by R. Maslin, A. W. Herre, H. S. Fitch, L. M. Klauber and C. B. Perkins. Fitch's field study provoked a great deal of discussion. The final symposium was a joint session with the Western Society of Naturalists, and was entitled "Africa, Zoologically Speaking." The high light was a paper by Bailey Willis on geology and evolution in the Dark Continent. Other papers on evolution were by C. Stock concerning mammals and G. S. Myers on fishes. R. B. Cowles, Sarah Atsatt and A. Van der Horst presented papers on modern Africa.

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The remaining three sessions were allotted to papers in the field of physical and inorganic chemistry. In the first session of this group a number of papers on the molecular structure of some organic and inorganic compounds were given and in addition one paper described the use of punched cards in calculations of molecular structure. A second session was devoted to the presentation of papers dealing with radioactivity and thermochemistry and among the topics considered were: fission products from uranium 238, chemistry of radio hydrogen (tritium), the heat capacity of gaseous paraffin hydrocarbons, the entropy of methyl mercaptan and the thermal decomposition of dimethyl acetal. The final session was devoted to the consideration of such papers as the quantitative stability relationship between the various forms of silica, the mercurous bromide electrode, the dissociation of salts in solvents of low dielectric constant and the use of phase diagrams in the classification of liquid crystalline phases.

In addition to the above a number of laboratory demonstrations were arranged in both physical and organic chemistry and the meeting was concluded with a joint dinner with the Southern California section of the American Chemical Society.

#### AMERICAN METEOROLOGICAL SOCIETY

(Report by G. M. Sheldon, Jr.)

The Pasadena meeting of the American Meteorological Society, held in conjunction with the meeting of the Pacific Division of the A.A.A.S., was well attended and all the seventeen papers presented, during the four half-day sessions, were of exceptional interest. The meeting was closed with a luncheon Friday noon, after which was shown a motion picture in color on "Cold Front Phenomena."

The largest group at any one session was the approximately two hundred who attended the symposium on long-range forecasts on Thursday afternoon. The papers covering the theory and research and the preparation of the forecasts, given by Dr. Kriek, and the verification and results, given by Mr. Elliott, brought forth considerable comment and discussion.

The papers presented covered four general fields of research, namely, radiation and fogs, illumination climate, long-range forecasts and convective showers and thunderstorms.

The officers of the Los Angeles Seminar for the coming year were introduced: *Chairman*, Dr. J. Bjerknes, University of California at Los Angeles; *Vice-Chairman*, Kenneth Fink, of the U. S. Weather Bureau at Los Angeles; *Secretary-Treasurer*, D. C. Tandy, of the American Airlines, Inc., at Burbank.

#### AMERICAN PHYSICAL SOCIETY

(Report by Paul Kirkpatrick)

Sessions for the presentation of brief contributed research reports were held on Wednesday, Thursday and Friday forenoons. These reports, thirty-five in number, touched upon theoretical and experimental investigations in varied fields, with purely theoretical papers concentrated in the Wednesday morning program. Diverse topics were grouped in the Thursday program, while Friday's session consisted of x-ray and spectroscopic contributions.

Two symposia concerned with applications of physics in adjacent fields were presented at the Wednesday and Thursday afternoon sessions. On Wednesday the society met in joint symposium with the Astronomical Society of the Pacific to consider dynamical phenomena of atmospheres in general and specifically that of the sun, earth and other planets. Papers by J. Holmboe, J. Strong, E. C. Slipher and S. B. Nicholson were heard. The symposium of Thursday afternoon upon electron microscopes was addressed by Otto Beeck, Alfred Marshak and William V. Houston. Many industrial, biological and chemical applications, projected and accomplished, were presented. A motion picture of the RCA electron microscope was shown. Following the symposium the audience was invited to witness Professor Houston's two-stage electron microscope in operation.

On Wednesday evening a joint dinner was held with the Astronomical Society of the Pacific; and at a physics luncheon on Thursday the group was addressed by President George B. Pegram, of the American Physical Society.

#### AMERICAN PHYTOPATHOLOGICAL SOCIETY, PACIFIC DIVISION

(Report by C. E. Yarwood)

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Salt Lake City, Utah, will be the scene of the 1942 meetings.

AMERICAN SOCIETY OF PLANT PHYSIOLOGISTS,  
WESTERN SECTION

(Report by J. van Overbeek)

The attendance ranged from 60 to 200. Three joint symposia were held and twenty-eight miscellaneous submitted papers were presented. D. R. Hoagland presided at a symposium on micronutrient deficiency diseases of crops. The characteristics of zinc deficiency, which causes more trouble in good than in poor soils and to which woody plants are more susceptible than herbaceous plants, were discussed by W. H. Chandler. E. L. Overholser reviewed boron deficiency in the Northwest, while J. E. Knott discussed copper, manganese and iron deficiency in the East. J. P. Bennett stressed the importance of colloidal iron, which is available from pH 3 to 9. W. T. McGeorge discussed soil chemistry. F. W. Went presided at a plant hormone symposium. He discussed chemical specificity of auxins. J. P. Bennett showed evidence of a substance which breaks the dormancy of trees. James Bonner refuted the popular notion that vitamin B<sub>1</sub> promotes the growth of horticultural plants. J. van Overbeek discussed dwarfism in corn due to excessive auxin destruction. He also showed that injection of naphthalene-acetic acid into *Datura* ovaries produces "seeds" containing non-viable pseudoembryos. A symposium on protoplasm was headed by O. L. Sponsler, who discussed relative size of protoplasmic constituents. A. R. Moore discussed essential factors in protoplasmic movement and A. L. Cohen the causes of form determination.

Air-conditioned greenhouses and fruiting of tomatoes under controlled conditions were discussed by F. W. Went. F. T. Addicott reported reduced meristematic activity in isolated roots lacking vitamin B<sub>6</sub>. H. E. Hayward discussed suberized layers in the root cap due to high chloride concentrations. M. A. Joslyn discussed succinic acid formation in yeast. P. W. Rohrbach measured biologically ethylene in motor gases. G. H. Harris found sulfur important for raspberries. A highly instructive demonstration was given by W. Z. Hassid showing that glucose phosphate is immediately converted into synthetic starch when phosphorylase is added.

A. Goetz found yeast extremely susceptible to silver ions. D. R. Hoagland and T. C. Broyer presented experiments on the importance of respiration for accumulation of solutes and permeability to bromide in roots. J. van Overbeek showed evidence for water uptake by forces other than osmosis. R. Emerson showed that phycocyanin is effective in photosynthesis. P. J. Allen found a 700 per cent. increase in respira-

tion of wheat leaves after infection with mildew. D. M. Bonner discussed four groups of chemicals promoting growth of isolated leaf tissue. J. Bonner showed that translocation of B<sub>1</sub> is similar to that of other plastic materials. D. I. Arnon found that no nutrients are absorbed at pH 3, while at pH 9 only no phosphorus is absorbed. F. G. Leibig showed that small amounts of aluminum increase copper tolerance. W. W. Aldrich reported 55 per cent. starch in date trees. Soil moistures can not be controlled below field capacity, according to A. H. Hendrickson. The effect of pruning on regeneration of top growth was discussed by A. H. Cameron. O. F. Curtis found that carotenes decrease in mineral-deficient plants, while A. L. LeRosen stressed the necessity of a gene R for carotenes in tomatoes. A. S. Crafts discussed a paper by R. N. Raynor on selective weed-killing ability of phenol compounds. W. O. Williams showed improved techniques for potassium titration.

Excursions were held to Riverside and Santa Ana.

Officers for the coming year: *Chairman*, J. van Overbeek; *Vice-Chairman*, E. T. Bartholomew; *Secretary*, D. I. Arnon.

ASSOCIATION OF PACIFIC COAST GEOGRAPHERS

(Report by J. E. Williams)

The seventh annual meeting of the Association of Pacific Coast Geographers was held at the California Institute of Technology at Pasadena, California, on June 18-20, 1941, where eighteen papers and a symposium on the Pacific Basin were presented.

The first paper on "Conservation and Chorology," by Dr. Kuchler, emphasized the importance of knowing the symbiotic balance in the landscape before attempting conservation. Dr. Bissell brought out the relation of climate to the prehistoric settlement of Chaco Canyon, New Mexico. Dr. Hoover described the natural beauty of the Havasu Canyon of Arizona. Next, Dr. Martin gave an excellently illustrated paper on the Zuyder Zee Reclamation Project. The morning session was closed by a discussion of the glacial retreat in the Lake Chelan region of Washington by Dr. Freeman.

The group gathered for luncheon and were able to see Dr. Hoover's film on Havasu Canyon.

In the afternoon, Mr. Gerlach presented "The Climates of California" from the standpoint of variation between desert, steppe and Mediterranean types. The determining factors in location of early Los Angeles were outlined by Dr. Baugh. The land-forms of the San Gabriel Mountains were next analyzed from a study of their Quaternary history by Dr. Williams. A paper on the black sands and terraces of Monterey by Dr. Beard analyzed the commercial use of various minerals found there.

A preliminary report on the status of geography in the junior colleges of the Pacific Coast was given by Mr. Buonristiani. The shearing of trees by a steady directional wind was proved to be a mechanical process, by the facts of Dr. Richardson's paper. Dr. Zierer discussed the relationship of the urban forms of Melbourne to its significance as a functional center. Dr. Spencer analyzed the effect of the present migrations in China on the Chinese culture and the absorption of the non-Chinese. The ambitious program of mapping the State of California was described by Dr. Miller, of the California State Planning Board.

The afternoon session was a symposium on the Pacific Basin, with Dr. Spencer as chairman. Contrasts of the occidental and oriental rural landscapes turned out to be more like similarities.

The president's address, given by Dr. Earle at the dinner, was an interesting study of house types, both oriental and occidental. She emphasized the function of the various house units in many localities.

The officers for the coming year are: *President*, Dr. Forrest Shreve, Desert Laboratories, Tucson, Arizona; *Vice-President*, Dr. Eliot G. Mears, Stanford University; *Secretary-Treasurer*, Dr. Willis H. Miller, California State Planning Board, Sacramento, California.

#### THE ASTRONOMICAL SOCIETY OF THE PACIFIC

(Report by R. E. Wilson)

A joint session with the American Physical Society was held on Wednesday afternoon, June 19, to hear a symposium on "The Dynamics of Atmospheres." Dean George B. Pegram, of Columbia University, president of the Physical Society, presided. The attendance was about 150. The theory of the hydrodynamics of rotating atmospheres was presented by J. Holmboe, of the University of California at Los Angeles, and John Strong, of the California Institute of Technology, discussed the emission and absorption of infra-red radiation in the earth's atmosphere. E. C. Slipher, of the Lowell Observatory, summarized the work of many years at that institution on the atmospheres of the planets, his many excellent photographs revealing marked changes from day to day, notably in the polar caps of Mars. The remarkable changes continually taking place on the surface of the sun were illustrated by photographs and discussed by S. B. Nicholson, of the Mount Wilson Observatory.

Three sessions for papers were held under the chairmanship of A. S. King, R. J. Trumpler and W. S. Adams. The average attendance was about 55. The twenty papers presented covered a rather unusual variety of subjects from instrumentation to theory and from terrestrial phenomena to the extragalactic nebulae. Edison Pettit described a new polarizing mono-

chromator for viewing solar prominences. This instrument was in operation on Mount Wilson on Thursday and aroused considerable interest. F. Zwicky described a mosaic grating for use with the Schmidt telescope. Among the papers of special interest relating to the sun were descriptions by Mary F. Coffeen of a new table of solar wave-lengths in the infra-red, a cooperative work of the Mount Wilson and Princeton Observatories, and by H. D. Babcock of a new method of measuring the sun's general magnetic field. D. R. Barber reported a significant correlation between the luminosity of the night sky and the activity of the earth's magnetic field during the preceding twenty-four hours. Andrew McKellar discussed in one paper the structure of one of the cyanogen bands in the spectrum of Comet Cunningham and in another the problem of the possible molecular identification for certain interstellar lines. Three papers dealt with eclipsing binary systems: R. M. Petrie presented evidence of apsidal motion in the orbit of AR Cassiopeiae; A. H. Joy discussed the absolute dimension of WW Draconis; and O. C. Wilson showed from observations of  $\epsilon$  Aurigae at the 1939-40 eclipse that both the turbulence in the atmosphere of the larger star and its excitation temperature increase with height. A. van Maanen announced the discovery of more than two dozen new faint members of the Pleiades cluster, extending knowledge of the content of that interesting assembly to stars of photographic magnitude 17.5. Two papers on the motions of the long-period variable stars by P. W. Merrill and R. E. Wilson pointed out a marked dependence of the dispersion in the radial velocities on the period of light variation, an asymmetry in motion apparently associated with galactic rotation, and a definite correlation between their mean luminosities and periods. R. Minkowski presented evidence that there are two and possibly three kinds of supernovae. Carl K. Seyfert suggested that broad emission lines found in the spectra of the nuclei of three extragalactic nebulae, lines commonly found narrow in galactic planetary nebulae, may be broadened as the result of the motions of the stars or gases in the nuclei.

An informal dinner with the American Physical Society was held at the Athenaeum on Wednesday evening. The last session for papers was held in the auditorium on Mount Wilson, after which the various telescopes and pieces of equipment were on display. The observatory was host to the members of the society for a supper at the monastery, after which the 100- and 60-inch telescopes were opened for observations. On Friday about 35 of the members took a trip to Mount Palomar, where the 200-inch and the Schmidt telescopes were exhibited by members of the staff.

## BOTANICAL SOCIETY OF AMERICA, PACIFIC SECTION

(Report by Ira L. Wiggins)

The program of the Pacific Section consisted of two symposia, three half-day sessions for the presentation of submitted papers, a luncheon attended by members of the American Society of Plant Taxonomists and other botanists and a field trip to the Rancho Santa Ana Botanic Garden.

The Wednesday morning program of submitted papers dealt with genetic and cytological problems and that of Thursday morning contained papers on morphology and anatomy of flowering plants, the effect of ethylene chlorhydrin on potato tubers and algological investigation on the Pacific Coast of North America. No program was scheduled on Wednesday afternoon in order that members of the Botanical Society might visit the U. S. Regional Salinity Laboratory at Riverside, California.

A joint symposium with the Western Section of the American Society of Plant Physiologists on Thursday afternoon, June 19, considered plant hormones, with F. W. Went, J. P. Bennett, James Bonner and J. van Overbeek presenting stimulating papers.

The symposium on protoplasm held jointly with the American Society of Plant Physiologists on Friday morning included four interesting papers by O. L. Sponsler, A. R. Moore, S. C. Brooks and A. L. Cohen. The molecular, colloidal and physical properties of protoplasm, the role of protoplasm in regulating cellular permeability and the organization of protoplasm as revealed by studies on slime molds were discussed.

The final session for presentation of submitted papers was held on Friday afternoon, June 20. A paper dealing with the ecological relationships among certain desert plants presented by F. W. Went excited considerable discussion as did one reporting results of experiments on the germination of seeds of native California plants. Other papers dealt with the taxonomy and geographical distribution of the *Suprolegniaceae* and of several groups of flowering plants.

At the annual business meeting held on Thursday morning, the following officers were elected: *President*, C. E. Owens; *Secretary-Treasurer*, Basset Maguire; *Council Member*, P. A. Munz.

Through the generosity of Mrs. Susanna Bixby Bryant, director, an extremely interesting visit and a delightful luncheon at the Rancho Santa Ana Botanic Garden were enjoyed by about twenty-five members of the Botanical Society and of the American Society of Plant Physiologists on Saturday.

## CALIFORNIA ACADEMY OF SCIENCES

(Report by Joseph Goodman)

The California Academy of Sciences sponsored a symposium on "Natural Illumination" on Wednesday

morning, June 19. About 75 persons were in attendance. A. Breese explained the concept of illumination climate. R. C. Miller reported on the behavior of birds, insects and other organisms with reference to morning and evening twilight. H. F. Blum discussed the possible role of the shorter wave-lengths of sunlight in causing cancer of the skin.

The symposium concluded with a round table discussion by biologists, physicists and meteorologists of the need for a coordinated program for the measurement of solar radiation as received at the earth's surface. A resolution was introduced and unanimously passed requesting Dr. R. C. Miller as director of the California Academy of Sciences to form a committee under the auspices of the academy to work out such a program on the widest practicable basis.

## ECOLOGICAL SOCIETY OF AMERICA, WESTERN SECTION

(Report by H. de Forest)

Twelve papers reporting research were presented in two half-day sessions, with the fields of animal and plant ecology represented about equally. Interesting brief discussions followed most of these papers.

In addition seven papers were given in two symposia. One of these, on "Ecological Aspects of Evolution," attracted a particularly large attendance. This symposium comprised papers by W. M. Hickey on the relations between climate and intraspecific variation in plants, by G. L. Stebbins on polyploid complexes in relation to ecology and the history of floras, by A. H. Miller on habitat selection among the higher vertebrates and its relation to intraspecific variation, and by J. van Overbeek on physiological aspects of the problem of ecology and evolution. The second symposium, on "The Development of Quantitative and Experimental Work in Ecology," consisted of papers by W. D. Billings on quantitative correlations between vegetational change and soil development, J. S. Horton on quantitative analysis of chaparral by quadrats, and L. R. Penner on effects of temperature and moisture on the distribution and incidence of parasites.

A pleasant ecologists' luncheon was held on one of the meeting days.

## THE OCEANOGRAPHIC SOCIETY OF THE PACIFIC

(Report by C. L. Utterback)

The program of the sixth annual meeting of the Oceanographic Society consisted of a symposium on "Coastal Currents of North America," a half-day session of contributed papers, and the annual luncheon and business meeting.

The symposium papers were prepared by Dr. R. H. Fleming, of the Scripps Institution of Oceanography, O. E. Sette, of the United States Fish and Wild

Life Service, and Dr. Richard Van Cleave, of the California State Fish and Game Commission. Due to the absence of Dr. Fleming, his paper was presented by H. U. Sverdrup. The speakers described the distribution of the halibut eggs and larvae in relation to the ocean currents in the region of Cape St. James on the southern end of Queen Charlotte Island and the distribution of the pilchard eggs and larvae in relation to the ocean currents off the coast of Southern California. The papers were followed by a discussion of various parts of the researches.

The Thursday afternoon program of contributed papers concerned different phases of oceanography. Dr. B. Gutenberg presented some of the results of his researches on earthquakes and submarine topography. An interesting account of ten years with the *Valero III* was given by Dr. C. M. Fraser. Other papers were concerned with certain aspects of the chemistry of the ocean. Two other papers presented results of studies of current configuration in selected areas.

At the annual business meeting on Wednesday noon the following officers were elected: *President*, Dr. R. C. Miller, director of the California Academy of Science; *Vice-President*, Professor A. H. Hutchinson, of the University of British Columbia; *Member of the Executive Committee* (two-year term), Dr. Richard Van Cleave; *Secretary-Treasurer* (three-year term), Professor C. L. Utterback, of the University of Washington.

SOCIETY OF AMERICAN BACTERIOLOGISTS, NORTHERN CALIFORNIA-HAWAIIAN BRANCH, SOUTHERN CALIFORNIA BRANCH

(Report by Ruth L. Conrad)

The two western branches this year combined to present a program of wide interest range at their half-day session.

Dr. M. Ball pointed out that an unknown growth factor exists in serum, probably non-protein in nature. It has a greater growth-stimulating effect than nicotinic acid.

A new mold in the field of allergy, *Epicoccum*, was reported by Dr. O. A. Plunkett to have air-borne spores prevalent in May rather than in October, the peak for most mold spores in the Los Angeles area.

The sensitivity of pneumococci to sulfapyridine was of general interest. Dr. F. J. Moore described a rapid qualitative test for resistance based upon the inoculation of sputum into treated and untreated mice. It was found that patients fall into four groups in respect to their response to chemotherapy.

The isolation of phages from normal strains of *Staph. aureus* and the failure to detect them on strains of *Staph. albus* was reported by Dr. Roy T. Fiske.

The report of Dr. W. W. Smith that hydrogen zeolites are more superior to sodium zeolites in lowering the bacterial count of water was of particular significance because of the arrival that day of the Colorado River water.

Dr. G. A. Matson came from Salt Lake City to tell us of his work on determining the racial purity or crossing among some of the Indians by means of the blood groups.

Tissue selectivity of strains of *Torula histolytica*, incidence and control of avian *Salmonella* infections, the marked reduction of bacterial flora of mackerel due to fast-freezing, studies on hydrogen sulfide production, the use of marked antigens and the oligodynamic action of silver were also reported.

Following the meeting, members of the group enjoyed a luncheon at the Athenaeum.

SOCIETY FOR EXPERIMENTAL BIOLOGY AND MEDICINE

(Report by D. M. Greenberg)

The Pacific Coast and Southern California branches of the Society for Experimental Biology and Medicine held a joint meeting on Friday afternoon, June 20. The officers of the Southern California Branch, Dr. Emil Bogen, *Chairman*, and Dr. Max S. Dunn, *Secretary*, conducted the program.

About one hundred were in attendance and interest was maintained throughout the whole of the program. Thirteen scheduled papers on subjects ranging from parasitology to biochemistry and biophysics were presented.

The variety is shown by the following topics covered: "Does *Trypanosoma cruzi* Chagas exist in man in the United States?" by S. F. Wood; "A comparison of the chemical and biological changes in beans produced by fertilization with the excreta of cats fed on adequate and deficient diets," by F. M. Pottenger, Jr., and D. G. Simonson; "Hemorrhage control in *Eimeria tenella* infected chicks when protected by the anti-hemorrhagic factor, Vitamin K," by F. M. Baldwin, O. B. Wiswell and H. A. Jankiewicz; "A study of carbohydrate metabolism in subacute thiamin deficiency," by H. A. Harper; "The comparative glycolytic and ketolytic activity of the hexitols," by C. Johnson and H. J. Deuel, Jr.; "The strength-duration curve of nerve excitation by means of electrical fields," by J. A. Gengerelli; "The effect of Higuieronia on the nematelmintic gastric ulcers of California sea lions," by C. M. Herman; "The effect of decomposition on brain tissue," by W. A. Hilton; "Tracer studies with induced radioactive isotopes of the permeability of the blood-cerebrospinal fluid barrier to ions," by D. M. Greenberg, R. B. Aird, M. D. D. Boelter, W. W. Campbell, W. E. Cohn and M. M. Murayama; "Effects of x-rays and neutrons on chromosomes and on phos-

phorus metabolism of nuclei," by A. Marshak; "Protein and energy utilization in riboflavin-deficient chicks," by M. Kleiber and T. H. Jukes; "Some analyses of purified poliomyelitis virus," by Hubert S. Loring and C. E. Schwerdt; "The effect of a water-soluble lemon peel extract on the circulatory system," by A. J. Leser, C. F. Lombard, C. H. Thienes, C. Wawra and J. L. Webb.

At the end of the afternoon session, a dinner was held for the group.

#### WESTERN SOCIETY OF SOIL SCIENCE

(Report by W. P. Martin)

The meetings of the Western Society of Soil Science were featured by a larger attendance, a more diverse program and greater discussions than heretofore. Approximately eighty soil scientists listened to and discussed thirty-one papers on current research during four half-day sessions. In addition to the above, six papers were presented during a symposium on deficiency diseases of plants under the chairmanship of D. R. Hoagland in which the soil scientists collaborated with the plant pathologists, the plant physiologists and the horticulturists.

Papers ranged from a description of the physical and chemical characteristics of mature soil profiles by J. Thorne to studies on the effect of root-nodule bacteria on seed pea production by S. C. Vandecaveye. Early sessions were devoted principally to the physical properties of soils, with papers being presented by J. E. Fletcher, L. H. Smith and P. I. Vlasoff, of the Soil Conservation Service, and O. W. Israelsen, G. B. Bodman, L. T. Kardos and J. P. Martin, of the State Agricultural Experiment Stations. Numerous papers presented various aspects of the moisture problem in

Western soils; R. E. Moore, P. R. Day, J. R. Furr, L. A. Richards, R. F. Reitemeier, M. R. Huberty, T. F. Buehrer and I. S. Vanoni were active in this respect.

Papers on the significance of Donnan equilibria in soils and errors inherent in the interpretation of pH measurements were given by L. E. Davis and P. R. Stout. J. P. Conrad, A. B. Caster, W. P. Martin, J. S. Jones, D. W. Thorne and L. T. Kardos presented papers on the retention by soils of the nitrogen of amino acids, nitrite build-up in the oxidation of ammonia and a threshold pH for same, organic matter changes in dry farm soils, and both zinc deficiency and arsenic toxicity in soils, respectively. Two related papers on plant tissue analyses as an aid to diagnosing nutrient deficiencies of crops and the potash content of citrus trees in relation to the supply in the soil were presented by A. Ulrich, S. M. Brown and H. D. Chapman.

At the banquet on Tuesday evening, Dr. L. D. Batchelor, director of the Citrus Experiment Station at Riverside, discussed the work of the station relative to the fertilization of citrus trees, and M. E. McCollam showed a colored motion picture entitled: "Fertilizer experiments with *Ludina* clover pastures." Seventy persons were in attendance.

An interesting field trip to visit the laboratories of the United States Regional Salinity Laboratory and the Citrus Experiment Station at Riverside was made on Wednesday afternoon.

Officers of the society for the coming year are as follows: *President*, L. C. Wheeting, Washington State College, Pullman; *Vice-President*, T. L. Martin, Brigham Young University, Provo, Utah; *Secretary-Treasurer*, W. P. Martin, University of Arizona, Tucson.

## OBITUARY

### ERHARD FERNHOLZ

THE death of Dr. Erhard Fernholz occurred as the result of accidental drowning at Princeton, New Jersey, on December 14, 1940. Dr. Fernholz was born at Hiddenhausen, Westphalia, Germany, on June 9, 1909, and graduated from the Realgymnasium of Bünde in 1928. He received the degree of doctor of philosophy from Göttingen with highest honors in the Faculty of Mathematics and Natural Science in November, 1932, and during the following year worked on a stipend with Professor Windaus. From October 1, 1933, until March, 1935, he was university assistant in the Chemistry Faculty of Göttingen, in charge of the Biochemical Department of the Organic Chemistry Laboratory. In the spring of 1935 he received a fellowship from Princeton University on funds given the university by Merck and Company and came to this

country to work in the Chemistry Department, where he was associated with Professor E. S. Wallis.

In the course of eight years, Dr. Fernholz contributed more than forty papers to the chemical literature. At an early date he established himself as an uncommonly original and able investigator. Most of his earlier work was concerned with the sterols and bile acids, and he was soon recognized as a leader in this field. His work on the constitution of stigmastanol led directly to the first successful partial synthesis of progesterone, accomplished independently by Fernholz and by Butenandt. This work established the structure of progesterone proposed by Slotta.

After coming to the United States, Dr. Fernholz continued to contribute papers on the steroids and maintained an active interest in the field. It was his desire to determine the structure of the more impor-

tant phytosterols, many of which are but poorly characterized.

In addition to his contributions to the steroid field, Dr. Fernholz performed outstanding research on other natural products. Soon after joining the research staff of Merck and Company, in 1937, he reported the isolation of durohydroquinone from the thermal decomposition products of  $\alpha$ -tocopherol, the most active principle of Vitamin E concentrates. This furnished the essential clue to the structure of  $\alpha$ -tocopherol, and in 1938 enabled Dr. Fernholz, almost entirely on the basis of his own experiments, to announce the complete structure of  $\alpha$ -tocopherol. Subsequent work from other laboratories has completely confirmed this structure.

Early in 1938, Dr. Fernholz became head of the Division of Organic Chemistry of the newly founded Squibb Institute for Medical Research. While continuing his active interest in steroids, he also turned his attention to the Vitamin K problem, and with his colleagues contributed eight papers concerned with the chemistry of antihemorrhagic substances. He was the first to recognize that 2-methyl-1,4-naphthoquinone was biologically more active than the natural Vitamin K<sub>1</sub>, a phenomenon unique among physiologically active natural substances.

Dr. Fernholz possessed the ability to visualize a research problem in its correct perspective, and therefore was able to reduce essential laboratory work to a minimum. It is not mere rhetoric to say that science has suffered a severe loss in his untimely death. More than that, all those who have had the privilege of being associated with him as colleagues or of being counted among his friends are acutely aware of a great personal loss.

GEORGE A. HARROP  
HOMER E. STAVELY

THE SQUIBB INSTITUTE FOR MEDICAL RESEARCH

### RECENT DEATHS

DR. ROBERT THOMAS HILL, geologist of the U. S. Geological Survey from 1889 to 1904, died on July 28 in his eighty-third year.

DR. JOHN FRANCIS WOODHULL, professor emeritus of physical science at Teachers College, Columbia University, from 1888 to 1922, died on July 27 at the age of eighty-four years.

DR. JOHN PRICE CROZER GRIFFITH, emeritus professor of pediatrics in the Graduate School of Medi-

cine of the University of Pennsylvania, died on July 28. He was eighty-five years old.

DR. MAX AARON GOLDSTEIN, the otolaryngologist, founder and director of the Central Institute for the Deaf at St. Louis, died on July 27 at the age of seventy-one years.

BENJAMIN LEE WHORE, assistant secretary of the Hartford Fire Insurance Company, research fellow of the Committee on American Native Languages of the American Council of Learned Societies, known for his work on Aztec and Mayan civilizations, died on July 26. He was forty-four years old.

DR. EDITH FORD SOLLERS, assistant professor of chemistry at Connecticut College, died in Baltimore on July 27 from injuries sustained in a laboratory accident while she carried on voluntary research in connection with the National Defense program.

PROFESSOR MYRON HARMON SWENK, chairman of the department of entomology of the University of Nebraska, died on July 17 in his fifty-eighth year. He became a member of the department of entomology in 1907 and was appointed chairman of the department in 1922, a position which he retained until the time of his death. According to a correspondent, "throughout the course of his professional career he has been actively engaged in both teaching and research and has contributed a large number of publications on various phases of entomology, particularly in the fields of economic entomology and taxonomy. In addition, he has published numerous articles in the fields of ornithology and mammalogy. In the death of Professor Swenk the University of Nebraska has lost one of its outstanding men."

A CORRESPONDENT writes: "The recent death of James Henry Blake, zoologist and artist, at the age of 96, removes almost the last of Louis Agassiz's students and coworkers. Mr. Blake was a student at the Penikese Laboratory and a member of the Hassler Expedition in 1871-72. He was also one of the artists for the famous Vineyard Sound Survey of the U. S. Fish Commission. At the time of his death, he was the senior member of the Boston Society of Natural History (elected 1870), in which he had held various offices. In addition, he was a founder and former president of the Boston Malacological Club. His lifelong interest in whales and mollusks is fittingly perpetuated by a large collection of his colored drawings in the New England Museum of Natural History."

## SCIENTIFIC EVENTS

### THE ROYAL COLLEGE OF SURGEONS

DAMAGE caused to the Royal College of Surgeons, London, has been recorded in SCIENCE. Further par-

ticulars are given by the London correspondent of the *Journal* of the American Medical Association, who writes:

The lecture room, where discourses have been heard for a century from almost all the leaders of British surgery, is now a charred ruin. The main block of the library remains with books still on the shelves, but its state is too dangerous for use. Nearly ninety thousand volumes had been sent to various parts of the country after damage by blasts from a previous raid. The transfer was aided by a grant from the Rockefeller Foundation. The principal treasures of the library had been sent away before the outbreak of the war. But the museum, which possessed treasures such as no other country could boast, has suffered irreparable loss, although many of the most valuable specimens were saved by having been placed in a tunnel below the basement surrounded with sand. The basement covers a wide area, and most of it escaped the fire that occurred. Many rooms, cellars and tunnels connected with it, which had been reinforced, were used for other specimens, which were not damaged. The important college records and historical documents had been sent away. But the working records dealing with the specimens, saved in the basement and subbasement, and the records of pathologic specimens presented to the college during the last few years were destroyed. The preservation of copies of the museum catalogues had been carefully considered and insured. All were saved except the catalogue of part of the pathologic section and that of the curio room, but nearly all the specimens in this room are described in the "Guide to Surgical Instruments and Objects in the Historical Series." Of the famous Hunterian collection, which forms the basis of the museum, no fewer than 3,750 specimens have been saved. Of the collections illustrating human anatomy only 20 specimens have been saved. Of 5,200 mammalian specimens illustrating comparative osteology only 20 or 30 remain and hardly any of 3,000 avian specimens or of the large amount of amphibian, reptile and aquatic material. The two rooms built in the middle of the last century, containing physiologic and comparative anatomy specimens, have been blasted away. Much anthropologic material has been destroyed, including the fine collection of primitive Tasmanian and Australian skulls. The greater part of the large collection of instruments is safe and can be restored. Among these are the instruments of Lister and of Moynihan, the Chinese and Japanese collections and the series illustrating the evolution of anesthetic apparatus. Though irreparable loss has been suffered, the destruction is not so great as was at first feared. Enough has been saved for the basis of a new museum, which will continue the Hunter tradition, which has always been fundamental in the college.

#### EXPEDITIONS OF THE AMERICAN MUSEUM OF NATURAL HISTORY

For the fifth consecutive season, Dr. Walter Granger, curator of fossil mammals at the American Museum of Natural History, will join a fossil-hunting expedition into the Big Badlands of South Dakota this summer. Dr. Granger left New York on July 25 for the headquarters of the expedition in Rapid City, S. D., where he will join Albert Thomson

and Dr. Edwin H. Colbert, of the department of paleontology, who have been at work since early July. The greater part of the field work will be concentrated in the northwestern part of the state. From this region, one of the richest fossil beds in the world, now set apart as a National Monument, the museum has obtained since its first expedition there in 1892, valuable remains of prehistoric animals that lived in the Oligocene period.

Two unusual specimens, obtained last summer through the cooperation of the Carter County Geological Society of Ekalaka, Mont., are now being studied. One is a giant rodent larger than the present-day beaver from the uppermost Cretaceous of southeastern Montana, and the skull of a dinosaur of a new and distinct genus, but similar to the smaller *Troodon* of earlier Cretaceous formations.

The first expedition to be conducted partly on skis for the museum is now being made by Peter E. Crow, of Cornell University, and Gilbert C. Anthony, of Dartmouth College, with the cooperation of the Marquis d'Albizzi, of Banff, Canada. The main object of this expedition is to make a representative collection of large and small mammals around the periphery of the Columbia Ice Field, the largest south of Alaska. With the Marquis d'Albizzi, Mr. Anthony will explore as great an area as weather conditions will permit, along the fringes of the ice field, on skis, while Mr. Crow, in the museum's station wagon, will collect mammals just off this region. The expedition will return to New York about September 1.

Mr. Michael Lerner, trustee of the museum, and Mrs. Lerner plan a hunting trip in the Yukon Territory. It is hoped to obtain two complete specimens of the Osborn caribou for a group in the North American Mammal Hall, now under construction. This caribou was first scientifically described by the late Professor Henry Fairfield Osborn, then president of the museum.

Dr. Harry L. Shapiro, associate curator of physical anthropology, is conducting a study of the Eskimos at Point Hope, Alaska. He is giving special attention to the physical anthropology of the group as a follow-up to the discoveries made last year by Dr. Froelich G. Rainey, who uncovered a prehistoric city of unknown culture on the great gravel spit of Point Hope. Dr. Rainey and Dr. Shapiro are continuing the excavation of the burial grounds.

#### AWARD TO THE BAUSCH AND LOMB OPTICAL COMPANY

THE U. S. Navy Department officially raised the flag of the Bureau of Ordnance and the Navy "E" pennant over the Bausch and Lomb Optical Company on August 2 "in recognition of outstanding performance in the production of ordnance materials."

The first local presentation to an industry was made by Admiral W. H. P. Blandy, chief of the Bureau of Ordnance, who addressed some 14,000 people composed of Bausch and Lomb employees and their families in ceremonies in the stadium of the Rochester Red Wings. The local ceremonies followed the reception of the heads of fourteen industries by Secretary Knox, who said:

In the present defense program, we've asked for miracles of industrial production and what's more, we're getting them. To show our appreciation of the way American industry has gone to bat in this emergency, the Navy has decided to award the Bureau of Ordnance flag and its coveted "E" to the management and men of those plants who are doing an outstanding job in the production of naval ordnance material. It's our way of saying "well done!"

According to Secretary Knox, the Navy hopes that the "E" award will be as eagerly sought by industry as it is by men in the service, to which it was formerly confined. The Navy "E" pennant has been a mark of excellence since 1906. It is usually awarded for outstanding performance in gunnery, engineering, battle practice or seamanship, and is one of the most coveted honors the Navy can bestow. It is usually painted on the funnel, mast, bridge or turret of a ship to designate the type of operation for which it was won. Each individual in the winning crew wears the "E" on his sleeve.

Bausch and Lomb employees will wear a pin carrying the insignia of the Bureau of Ordnance and the Navy "E." The company is also entitled to paint the letter on its smokestack.

In presenting the flag and "E" pennant to Herbert Eisenhart, president of Bausch and Lomb, Admiral Blandy said:

The purpose of making the award to Bausch and Lomb is exactly the same as in the Navy—to provide recognition for a job well done. We hope it will provide an incentive for every producer of naval ordnance to attain similar excellence in performing his own task for the nation's defense.

Mr. Eisenhart, president of the company, in accepting the flag, said in part:

Ever since the Spanish American War, over forty years ago, the Bausch and Lomb Optical Company has been cooperating with the Navy Department in the development and perfection of the fire control equipment for our Navy. Then in 1912 the Navy Department stationed here at our plant a resident inspector and this has materially helped this program of cooperative experimentation and production. Continually since then, these representatives of your department have been with us and this close relationship has been cordial, constructive and most valuable.

The instruments this company produced in the war of

1917 and 1918 demonstrated the effectiveness of this program. An outstanding accomplishment of this period was the first large-scale, successful production of optical glass—the great importance of which is now so apparent to all. Then through the following years we had continued with this close cooperative procedure. And now in this time of great national need it has been and now is our privilege to demonstrate again our ability to produce these much needed instruments for both Navy and Army.

It is an honor for me to accept this pennant for the company and the employees, for it is the teamwork of this great group gathered here which has made this possible. We shall do our best to continue to justify this public recognition.

### DEFENSE TRAINING COURSES OF COLLEGE GRADE

THE Society for the Promotion of Engineering Education has issued a pamphlet prepared by Dean R. A. Seaton, director of Defense Training Courses of College Grade of the U. S. Office of Education, with the cooperation of Dr. A. A. Potter, dean of engineering and director of the Engineering Experiment Station of Purdue University, and Dean G. W. Case, of the College of Technology of the University of New Hampshire and director of the Engineering Experiment Station.

Appropriations for defense training approved by President Roosevelt on July 1 amount to \$116,122,000, made up of the following items:

For cost of vocational courses of less than college grade, including not to exceed \$3,-500,000 for rental of additional space	\$52,400,000
For purchase or rental of equipment for courses indicated under (1) above	20,000,000
For the cost of short courses of college grade to meet the shortage of engineers, chemists, physicists and production supervisors	17,500,000
For the cost of vocational courses of less than college grade and related instruction for rural and non-rural youth	15,000,000
For the cost of vocational courses and related or other necessary instruction for young people employed on National Youth Administration work projects	10,000,000
For administrative expenses of the Office of Education and the Office of the Federal Security Administrator	1,222,000

Of the \$17,500,000 for courses of college grade, \$16,400,000 is for the training of engineers, \$500,000 for chemists, \$100,000 for physicists and \$500,000 for non-engineering production supervisors. While this division of the fund is not specified in the act, it was clearly indicated in the congressional committee hearings.

The new program of college-grade training will be called Engineering, Science and Management Defense

Training and will be administered in the U. S. Office of Education by the same staff that has been handling the Engineering Defense Training, except that specialists in the new fields are being added.

The Advisory Committee has been enlarged by the addition of Dr. Homer L. Dodge, head of the department of physics and dean of the Graduate School of the University of Oklahoma; Dr. Clare E. Griffin, dean of the School of Business Administration of the University of Michigan, and Dr. N. W. Rakestraw, professor of chemistry at Brown University. No change is contemplated in the regional advisers. One institutional representative will, as heretofore, be named by each participating institution.

### RESEARCH IN INDUSTRY

THERE was published in the last issue of *SCIENCE* a statement concerning the report of the survey of industrial research transmitted to the Congress by the National Resources Planning Board. The Committee on Survey of Research in Industry was composed of the following:

F. W. Willard, *chairman*, president, Nassau Smelting and Refining Company; C. L. Alsberg, director, Giannini Foundation of Agricultural Economics, University of California; C. H. Bailey, professor of agricultural chemistry and vice-director, Agricultural Experiment Station, University of Minnesota; Herbert A. Baker, president, American Can Company; Henry A. Barton, director, American Institute of Physics; L. W. Bass, assistant director, Mellon Institute of Industrial Research; Carl Breer, director of research, Chrysler Corporation; O. E. Buckley, president, Bell Telephone Laboratories, Incorporated; G. H. A. Clowes, research director, Eli Lilly and Company; W. D. Coolidge, director of research, General Electric Company; F. G. Cottrell; M. H. Eisenhart, president, Bausch and Lomb Optical Company; Charles N. Frey,

director, Fleischmann Laboratories; George R. Harrison, professor and director of the research laboratory of experimental physics, Massachusetts Institute of Technology; Maurice Holland, director, Division of Engineering and Industrial Research, National Research Council; Harrison E. Howe, editor, *Industrial and Engineering Chemistry*; Jerome C. Hunsaker, professor of aeronautical engineering, Massachusetts Institute of Technology; Martin Ittner, research director, Colgate-Palmolive-Peet Company; Frank B. Jowett, vice-president, American Telephone and Telegraph Company; John Johnston, director of research, United States Steel Corporation; Virgil Jordan, president, National Industrial Conference Board; F. T. Litchfield, consulting engineer and assistant vice-president, Wells Fargo Bank and Union Trust Company; L. W. Wallace, director, Division of Engineering and Research, Crane Company; E. R. Weidlein, director, Mellon Institute of Industrial Research; Frank C. Whitmore, dean of the School of Chemistry and Physics, Pennsylvania State College; R. R. Williams, chemical director, Bell Telephone Laboratories, Incorporated.

Members of the Science Committee of the National Resources Planning Board are:

Edwin B. Wilson, *chairman*, professor of vital statistics, School of Public Health, Harvard University; Arthur L. Day, vice-president, National Academy of Sciences; David L. Edsall, dean of Harvard School of Public Health, emeritus; Edward C. Elliott, president, Purdue University; Ross G. Harrison, *chairman*, National Research Council, and professor of biology, Yale University, emeritus; Dugald C. Jackson, professor of electrical engineering, Massachusetts Institute of Technology, emeritus; Charles H. Judd, dean of the Division of Education, University of Chicago, emeritus; Dexter M. Keezer, president, Reed College; Waldo G. Leland, director, American Council of Learned Societies; Charles R. Morey, Marquand professor of art and archeology, Princeton University; William F. Ogburn, professor of sociology, University of Chicago.

## SCIENTIFIC NOTES AND NEWS

DR. GILBERT N. LEWIS has retired from the administrative duties of dean of the College of Chemistry and chairman of the department of chemistry of the University of California. He will continue as professor of chemistry. Professor Wendell M. Latimer has been appointed dean of the college; Professor Joel H. Hildebrand, chairman of the department, and Professor C. W. Porter, director of the laboratory.

DR. CLYDE FISHER, curator-in-chief of astronomy and director of the Hayden Planetarium of the American Museum of Natural History, who has been a member of the scientific staff for twenty-eight years, retired on August 1 and will become honorary curator of astronomy and honorary director of the planetarium. He will be succeeded by William H. Barton,

Jr., who has been executive curator of the planetarium.

DR. JAMES B. HERRICK, professor of medicine emeritus of Rush Medical College, has been elected an honorary member of the Cardiac Society of Great Britain and Ireland.

DR. NORMAN R. STOLL, associate member of the Rockefeller Institute for Medical Research, Princeton, N. J., received recently the degree of doctor of science from Mount Union College, Alliance, Ohio.

PROFESSOR J. L. MYRES and Professor R. M. Dawkins, formerly presidents of the Society for the Promotion of Hellenic Studies, went from Oxford to Boar's Hill, the home of Sir Arthur Evans, to present

to him on behalf of the society an illuminated address congratulating him on his ninetieth birthday on July 8. Professor Myres also presented to Sir Arthur an address from the British School of Archeology in Athens, of which he was one of the founders and to which he presented some years ago the site of the Palace of Knossos and his property in Crete to be a center for Cretan studies. Sir Arthur was president of the British Association for the Advancement of Science during the period from 1916 to 1919.

JULIA BELL, honorary Galton research fellow of University College, London, and member of the scientific staff of the Medical Research Council, has been awarded the Weldon Memorial Prize for 1941 of the University of Oxford.

ALFRED H. WHITE, professor of chemical engineering and head of the department at the University of Michigan, has been elected president of the Society for the Promotion of Engineering Education. H. T. Heald, of the Armour Institute of Technology, and F. L. Eidmann, professor of mechanical engineering at Columbia University, have been elected vice-presidents.

WILLARD C. BROWN, executive engineer of the Nela Park Engineering Department of the General Electric Company, Cleveland, has been elected president of the Illuminating Engineering Society, and will assume office on October 1. Howard M. Sharp, manager of the Lighting Bureau of the Niagara and Eastern Power Corporation, Buffalo, N. Y., was elected vice-president.

THE New York Psychoanalytic Society and the New York Psychoanalytic Institute have elected the following officers for 1941-42: *President*, Adolph Stern; *Vice-president*, Lillian D. Powers; *Secretary*, Philip R. Lehrman, and *Treasurer*, Samuel Atkin.

DR. WARREN C. HUNTER, for many years associated with the department of pathology of the Medical School of the University of Oregon, has been promoted to a full professorship in pathology.

DR. JACK MYERS, national research fellow in the Division of Radiation and Organisms of the Smithsonian Institution, has been appointed assistant professor of physiology at the University of Texas.

CHANGES in the department of chemistry at the Oregon State College for next year include the promotion of Dr. Bert E. Christensen from assistant to associate professor; Dr. Lloyd E. West and J. G. Roof from instructors to assistant professors, and the appointment of Dr. Max B. Williams and Dr. Allen B. Scott as instructors. Dr. William E. Caldwell, head of the division of inorganic chemistry, has been

called for a year's active duty in the Chemical Warfare Service, Edgewood, Md., with the rank of major.

PROFESSOR GERMAINE GUIOT, of the department of physical education for women at the Iowa State College, has been named head of the department to succeed Professor Winifred Tilden, who has served since 1903. Professor Tilden will continue as professor.

DR. GREGORY MASON, who was organizer and leader of a number of archeological exploring expeditions to South America and Central America from 1926 to 1936, has been appointed head of the School of Journalism of New York University.

THE *Journal* of the American Medical Association reports that Dr. Myron E. Wegman, lecturer in public health in the School of Hygiene and Public Health of the Johns Hopkins University, since 1936 pediatric consultant of the bureau of child hygiene of the Maryland State Department of Health, is serving as assistant professor of child hygiene in the School of Tropical Medicine of the University of Puerto Rico, under the auspices of Columbia University, and as assistant director of the division of education and research in charge of child hygiene in the insular Department of Health.

DR. OTTO MARBURG, from 1919 to 1938 director of the Neurological Institute of the University of Vienna, has lost his case in the New York State Court of Appeals for a license to practice medicine in the state. By a vote of five to two, the Court supported the State Board of Regents and Dr. Ernest E. Cole, State Commissioner of Education, in their refusal to indorse his Austrian medical license, which would have entitled him to practice here without taking an examination. Dr. Marburg is now clinical professor of neurology at the College of Physicians and Surgeons of Columbia University, on a Rockefeller Foundation grant of \$5,000, and is research neuropathologist at Montefiore Hospital, the Bronx. He came to the United States in 1938, when he applied to the Board of Regents for a license without examination. After the application had been rejected twice, he applied to the courts. He won decisions in the Supreme Court and Appellate Division, but these have now been overruled.

VERNON LAMB, instructor in physical chemistry at the University of Maryland for the past three years, has joined the section of electrochemistry of the National Bureau of Standards, Washington, D. C.

WILLIAM T. SWEENEY has resigned his position as research associate for the American Dental Association at the National Bureau of Standards, Washington, D. C., to become director of research for the Vernon-Benshoff Company, Pittsburgh, Pa.

DR. SAMUEL GELFAN has taken up his work as di-

rector of research of the Van Patten Pharmaceutical Company, Chicago.

DR. EARL N. BRESSMAN, of the U. S. Department of Agriculture, has been appointed the United States representative on the Inter-American Commission of Tropical Agriculture. This commission was established to plan an Inter-American Institute of Tropical Agriculture and to encourage rubber production in the Western Hemisphere.

CHARLES F. GOLDTHWAIT has been appointed senior cotton technologist of the new Southern Regional Research Laboratory at New Orleans of the U. S. Department of Agriculture, and is in charge of the modified finishing section of the cotton chemical finishing division. He has worked on the chemical treatment of cotton at the Mellon Institute of Industrial Research.

DR. H. H. NEWMAN, professor of zoology emeritus of the University of Chicago, on July 9 gave a convocation address before the summer session of Indiana University on "The Use of Twins in the Human Heredity-Environment Problem." In the evening he also conducted an open seminar on multiple human births.

THE eighty-ninth annual meeting of the American Pharmaceutical Association will be held at Detroit from August 16 to 23.

THE American Dental Association will hold its eighty-third annual convention in the Sam Houston Coliseum, Houston, Texas, from October 27 to 31. Headquarters will be in the Rice Hotel.

A CONFERENCE on Visual Problems was held at the Ohio State University on June 18 and 19. It brought together leading scholars actively engaged in research on various problems of vision. The participants included representatives from the fields of visual psychology, neuro-physiology, physiological optics, colorimetry, biophysics, illumination engineering, optometry and ophthalmology. Speakers on the program included Professor Selig Hecht, of Columbia University, and Professor Walter R. Miles, of Yale University.

THE Boston Society of Natural History announces that original, unpublished essays on any subject in

the field of ornithology are eligible for the Walker Competition for 1942. Further information may be obtained from the Secretary, 234 Berkeley Street, Boston. The closing date is May 1, 1942.

It was stated in a recent number of SCIENCE that the University of Texas had received a grant for the establishment of "the first laboratory of marine biology on the Gulf of Mexico." We are now informed that the Louisiana State University has maintained a class in marine biology at Grand Isle since 1928, and has occupied its own building since 1936. The laboratory has had an instructional staff consisting of members of the departments of zoology and botany, also instructors from elsewhere, and guest workers, in addition to the regular student body. This summer the staff consists of Dr. E. H. Behre, Dr. H. J. Bennett, Dr. J. H. Roberts, all of the department of zoology of the university, and Dr. Lauretta E. Fox, of the Louisiana State Normal College. The laboratory is open and available during the winter season to independent workers who may wish to use the facilities for intermittent or continuous periods.

THE third summer course in industrial statistics will be given at the Massachusetts Institute of Technology from September 8 to 20. This course is intended for workers in industrial plants and scientific laboratories who would like to acquire the rudiments of modern statistical technique as applied to inspection, to the design and analysis of factory and laboratory experiments, and to control of the quality of industrial output. The course will include lectures, discussions and laboratory work on the following subjects: judging results based on one or more small samples, identification of factors responsible for poor and variable quality, specifications and risks of producers and buyers, methods of sampling and their relationship to inspection, methods of experimenting under ordinary factory conditions, the design and analysis of small scale laboratory experiments. These methods will be applied in detail to practical problems analyzed at the institute during the past several years. Inquiries should be directed to Professor George P. Wadsworth, of the department of mathematics, or to Professor Harold A. Freeman, of the department of economics.

## DISCUSSION

### ILLUSIONS IN PRINTED MATTER

RECENTLY Christian A. Ruckmick<sup>1</sup> described an optical illusion seen when a page of typewriting on onion-skin paper is laid upon a carbon copy of the same

writing. When the two sheets are about 5° from being parallel a series of white concentric circles can be seen. The circles are not complete, but are made up of a number of arcs separated from one another by intervening letters. The breaks in the circles are little more

<sup>1</sup> SCIENCE, 93: 2410, 236, March 7, 1941.

disturbing to the eye than are the breaks in a "dashed" curve in a graph.

Ruckmick's circles are not peculiar to himself. I can confirm him in all that he says, from having seen them many times, but can add a detail or two. It is not necessary to use onion-skin paper, for if the first sheet is rather thin and translucent, the carbon copy is not too pale, and the sheets are on a white background, the white circles are very conspicuous. The formation of an arc depends upon the alinement of spaces between words, and to be noticeable at least four lines are involved, two on the ribbon copy and their two carbon copies. Because of this, the chance of seeing arcs and circles is less with two pages of dissimilar typing than it is with Ruckmick's arrangement. In a half page of double-spaced typing, with every word having 7 or more letters, so that there were only 6 spaces on a line, there were only a few arcs. In another block of single-spaced typing, with an average of 4 letters to a word, the apparent arcs were numerous. On closer inspection they were seen to be practically straight lines, yet giving the illusion of forming broken circles.

When one of the specially typed blocks and its carbon copy are in exact register, the appearance is not unusual. If the ribbon copy is moved straight up or down about 3 mm, so that the lines are parallel to those of the carbon copy and there is no shifting to right or left, the typing will be crossed by a number of white lines at right angles to the lines of typing. Now, with the lines still 3 mm out of register and parallel, a shift of about a millimeter to the right or left will make the white lines slant in the same direction. These two shifts are for pica type and would no doubt be a little less for the smaller elite type.

Another optical effect has often forced itself upon the attention when carbon copies of letters were being handled. The copies are made on thin paper which most persons call green, but which has such a strong blue tone that at times what to call it is doubtful. If one of these sheets is lying in close contact on another on which the carbon copy is quite black, the writing can be seen through the upper sheet. In bright daylight the writing is sometimes quite noticeably red, sometimes reddish brown, or more often of no color to attract attention. For the benefit of those who may wish to think up a reason for this illusion it may be said that a thin smear of carbon black on white paper has a brownish tone, and to overcome this a violet or a red "toner," or sometimes both, must be added to the mixture that forms the coating on the carbon paper.

C. E. WATERS

WASHINGTON, D. C.

## DESIGNATION OF LOCATIONS ON MAPS

AN able plea in *SCIENCE* of February 16, 1940 (91: 169), for "increasing the usefulness of maps" asserted that "relatively few people are accustomed to making any use of latitude and longitude in the interpretation of maps." Doesn't this point to a lack in teaching emphasis?

Why propose new schemes of fractional subdivision in thirds, ninths, etc. (*SCIENCE*, 93: 68)? Does the superiority of decimal subdivision need further argument? Surely the measurement of two angles (*SCIENCE*, 93: 523) from the lower left and right map corners involves as much work to arrive at the "typical designation: Lake Nokoni, Rocky Mountain National Park Quadrangle, L 51½°, R 56½°" as does sliding a decimally divided scale along the even ten-minute map coordinate lines and reading as directly and without further computation 40° - 15.8' N., 105° - 42.6' W.

It is slight criticism of the almost universally used latitude-longitude subdivisions in degrees (and decimals or) minutes and seconds, that for military purposes an overprint is added to give precise plane rectangular coordinates in addition to the polyconic projection network. Or that geographers in laying out the map of the world on a scale of 1:1,000,000 prefer to designate the Boston sheet as North K 19. Division into "arbitrary regions . . . does not meet present needs," but designation, in hundredths even if warranted, makes minutes of arc as explicit as desired.

When confronted in the field with actual fences marking the quarter section lines, we are painfully reminded that in terms of customary land subdivision Lake Nokoni is in the N.W.¼, of the S.W.¼, of Section 31, of Township 4 North, Range 74 West, in Grand County, Colorado. And if this were farming country local residents may readily tell us in which sections their respective farms lie.

But why do we continue to follow the calf path backwards, just as we continue to address our mail, listing first the things we wish to know last? The postman sorting mail wants to know first the state, second the city, third the street, fourth the number, etc. Possibly that is why we are needlessly confused in trying to locate this particular 40 acres.

ROBERT H. MERRILL

GRAND RAPIDS, MICHIGAN

## INTERNATIONAL COOPERATION

ON reading Dr. A. V. Hill's essay which appeared in *SCIENCE* for June 20, 1941, I am led to make one small comment amplifying a parenthetical statement of fact in that article.

Dr. Hill remarks, with reference to the International Union for Mathematics, that "this last no longer exists." I have always understood that this Union lost the effectiveness it might have had and in the end went out of existence (in 1936, I believe) chiefly because the majority of mathematicians did not approve the political origins and development of the Union. However that may be, there is no ques-

tion that the mathematicians of the world had every reason to be pleased with the effectiveness of that rather informal but close cooperation which, among other things, made possible their successful and important quadrennial international congresses. It would be unfortunate if any of Dr. Hill's readers should draw a contrary inference.

MARSHALL H. STONE

## SCIENTIFIC BOOKS

### VITAMINS

*The Avitaminoses.* By WALTER H. EDDY and GILBERT DALLDORF. xii + 519 pages; index, 41 plates and 28 figures. Baltimore: The Williams and Wilkins Company. 1941. \$4.50.

THE first four chapters are essentially introductory in character. Chapter I, a very short chapter of eight pages called "Vitamins and Disease," is clearly and sensibly written and is admirably adapted for the orientation of the beginner seeking knowledge about vitamins. Chapter II, "The Chemical Nature of the Vitamins," and Chapter III, "Vitamins and Cellular Oxidation," are concisely and clearly expressed and adapted to the understanding of those pathologists and clinicians without profound knowledge of chemistry. Chapter III is, on the whole, a stimulating and clever job of exposition in outlining the achievements of biochemists in tracing processes involving complex compounds or systems in living tissues. Chapter IV on "Vitamin Requirements" is a seventeen-page condensed account of current information regarding human vitamin requirements, adequately documented.

Chapters V to XXII, inclusive, deal with the nature and functions of the various vitamins and the pathologic states arising from vitamin deficiencies.

Each chapter devoted to the nature and functions of a vitamin is succeeded by a chapter dealing with the respective avitaminosis as naturally occurring in man and animals, and as produced experimentally. The chapters on the avitaminoses contain very fair historical accounts of each subject and quite detailed clinical and pathological descriptions.

This arrangement or plan of the book, while a bit clumsy and leading to some unnecessary repetitions, is, on the whole, a very satisfactory device for covering a wide range of factual knowledge in an interest-sustaining manner. In the vitamin B group, pairs of chapters deal with vitamin B<sub>1</sub>, vitamin B<sub>2</sub> or G or riboflavin and vitamin P-P or nicotinic acid, the anti-human pellagra—the anti-black tongue factor for dogs. "The nature and function of other members of the B-complex" and "Deficiency diseases related to

the vitamin B complex" are covered in Chapters XI and XII—both rather brief though documented by satisfactory bibliographies. These two chapters require careful reading and seem less well done than those dealing with other vitamins, in part due to great condensation by the authors and in part due to the present undeveloped stage of knowledge, but on the whole they suffice to acquaint the reader with what is known about the subject-matter. Part I concludes with Chapter XXIII on "The Vitamins and Infectious Diseases," happily a short chapter, a bit speculative and not sufficiently analytical in appraisal of work cited.

Part II of the book, a total of thirty-eight pages, consists of Appendix A, on "Laboratory Tests Useful in the Diagnosis and Study of Deficiency Disease," and Appendix B, on "The Vitamin Content of Foods."

The procedures discussed in Appendix A do not represent a critical selection from the methods now available but are those, as stated in the preface, with which the authors have had experience. An expansion of this appendix with a good bibliography covering the field would have increased the value of the book.

Appendix B is composed of an impressive array of tables and apparently is adequately documented.

This book—"planned to be a helpful manual rather than a complete treatise"—achieves its purpose admirably in presenting "the field from clinical, chemical and pathological points of view." A critical reading of the book reveals many minor defects and gives the impression of having been hastily put together, somewhat carelessly in places, but nevertheless, with great ingenuity. As a compilation of factual knowledge, it is an outstanding book on the avitaminoses. As a scientific review it is inadequate in places and gives indication of the personal interests and biases of the authors.

The minor defects referred to could have been eliminated by careful reading of the manuscript by an intelligent secretary. The illustrations of the pathology, had the authors been willing to go beyond their personal work more freely, could have been much better chosen. It is to be hoped that in future editions

more and better chosen illustrations will be incorporated.

The reviewer has a guilty feeling in making these few derogatory comments because the authors have made an honest effort to achieve their purpose and have succeeded so well that the general reaction is one of gratitude for having placed on the market a book of such usefulness. The reviewer commends it to medical students and to the medical profession in general. For biochemists and pathologists it should serve to present admirable perspectives of each other's activities.

S. B. WOLBACH

HARVARD MEDICAL SCHOOL

### CELLS

*Unresting Cells.* By R. W. GERARD. xv + 439 pp. New York: Harper and Brothers. \$3.75. 1940.

THIS book is a straightforward, lucidly illustrated account of the structure, function, growth and reproduction of cells from the view-point of a physiologist. The author's reasons for writing a book of popular science are set forth in his preface as follows: "the scientist—yes, the pure scientist—is not merely justified in spending some energy on the popularization of sound science, but even more, has some duty to civilization to do so," . . . for, "scientists must help recruit men in other walks of life to the method and attitude of science in dealing with problems of state and society."

Following a brief account of the characteristic properties of protoplasm, two chapters deal with the

structure and simpler chemistry of protoplasm. Enzymes, their nature and activities, are treated in a long chapter which prepares the way for an account of metabolic processes. The questions of energy sources and the conversion of energy which crept into the previous chapters are then considered, with emphasis on the concept of free energy. Thus half of the volume is devoted to the more strictly physico-chemical aspects of cells.

The remainder of the book consists of an excellent account of irritability and behavior, an account of the structure and differentiation of cells as seen through the microscope, and then proceeds to the problems of reproduction and inheritance. The latter, treated largely as problems of the reproduction and inheritance of molecules, are superbly done.

The illustrations are consistently good, the lighter note in some of the drawings serving to get the layman over certain difficult bits of terrain. The drawing for the chapter head on heredity represents chromosomes of the giant salivary gland type (which never undergo mitotic division) in the process of dividing. This is the only striking inaccuracy in the book and will prove tantalizing to those cytologists who would like to see such chromosomes undergo division. There is a good index.

This is a stimulating volume which will be read with great interest by students of science as well as the layman, for Professor Gerard writes with clarity and enthusiasm, as well as with purpose.

D. F. POULSON

YALE UNIVERSITY

## REPORTS

### AWARD OF GUGGENHEIM FELLOWSHIPS FOR 1941

EIGHTY-FIVE fellowships with grants of funds amounting to \$180,000 to assist research and creative work to be carried on in the year 1941-42 by American and Canadian scholars and artists are announced by the John Simon Guggenheim Memorial Foundation. Last year seventy-three fellowships were granted and fifty-eight were awarded in 1939. The recipients were selected from more than fourteen hundred applicants. This is the sixteenth annual series of fellowship awards by the foundation, which was established and endowed by former United States Senator and Mrs. Simon Guggenheim as a memorial to a son.

The Guggenheim fellowships are granted to scholars and artists who by their previous work have shown themselves to be persons of unusual ability. Men and women, married and unmarried, of all races and creeds, who are citizens or permanent residents of the United States, citizens of Canada and of certain Latin

American countries, are eligible on equal terms. The fellows are usually of ages between 25 and 40 years. This year their average age is thirty-six years. The stipends are usually \$2,500 for a year.

Since its establishment sixteen years ago the foundation has granted 1,017 fellowships with stipends amounting to about \$2,300,000.

The following fellowships in the sciences have been awarded:

DR. CORNELIUS BECKER PHILIP, medical entomologist in the U. S. Public Health Service, stationed at the Rocky Mountain Laboratory, Hamilton, Mont., who will prepare a book on ticks and their relation to animal and human disease. He will work in Mexico, Colombia and Brazil.

DR. EDWARD HOLLAND SPICER, instructor in anthropology in the University of Arizona, will prepare a comparative study of the influences of contact with other cultures upon the Yaqui Indian communities of Mexico and Arizona.

DR. ISABEL TRUESDELL KELLY, of the University of

California, who is now in the State of Jalisco, Mexico, as a Guggenheim fellow, has been granted a second fellowship to enable her to continue her ethnographic and archeologic investigations there.

DR. MARGARET H. FULFORD, assistant professor of botany in the University of Cincinnati, will make a taxonomic study of the Hepaticae—liverworts—of Mexico and Central America, with the purpose of filling a gap in the existing botanical knowledge of the region.

DR. ARISTID V. GROSSE, of the Laboratory of Physics of Columbia University, formerly associate director of research for the Universal Oil Products Company, is working on the utilization of a close relative of the element uranium, known as U-235, as a source of power. This is the second Guggenheim fellowship to assist this work.

DR. HARVEY ELLIOTT WHITE, associate professor of physics, University of California, will make a spectroscopic analysis of the gases of the volcano Mauna Loa.

DR. MERRILL KELLEY BENNETT, professor of economic geography, Food Research Institute, Stanford University, proposes to investigate representative diets in the Hawaiian Islands and to contrast these with Oriental and Occidental diets.

DR. ADRIANCE SHERWOOD FOSTER, associate professor of botany, University of California, will go to Hawaii to make a cyto-histological study of the growth of buds of tropical ferns.

DR. ROY FRANKLIN BARTON, teacher of mathematics, St. Andrew's High School, Sagada, P. I., will record and translate the "Hudhud," a series of epics chanted as work songs and at death wakes by the Ifugaos, a pagan, terrace-building people of the Philippine Islands.

DR. DOROTHY MARY SPENCER, lecturer in anthropology, University of Pennsylvania, is engaged in studying, from an anthropological point of view, the Mundas, an aboriginal people who live on the high plateaus of Bengal, India.

DR. MAUD WORCESTER MAKEMSON, chairman of the department of astronomy and director of the Observatory of Vassar College, for researches into problems of Maya astronomy.

DR. ALFRED TARSKI, refugee mathematician from Poland, where he was professor of mathematics in the University of Warsaw, studies in the field of mathematical logic and the logical foundations of mathematics.

DR. DEANE MONTGOMERY, associate professor of mathematics, Smith College, studies of the action of topological transformation groups on various types of spaces, particularly on Euclidean spaces and manifolds.

DR. RICHARD DAGOBERT BRAUER, assistant professor of mathematics, University of Toronto, studies in the field of modern algebra, with special reference to the theory of groups of finite order and their characters.

DR. JESSE DOUGLAS, mathematician, Brooklyn, research in the calculus of variation and geometry.

DR. KENNETH STEWART COLE, associate professor of physiology, Columbia University, and consulting physicist, Presbyterian Hospital, New York City, for a study of the electrical aspects of the structure and function of living nerve.

DR. BERRY CAMPBELL, assistant professor of anatomy, University of Oklahoma Medical School, for investigations

of the integrative mechanisms of the spinal cord with particular reference to the basic locomotor behavior patterns. Dr. Campbell will work at the Rockefeller Institute for Medical Research with Dr. Herbert S. Gasser.

DR. BENJAMIN PAUL SONNENBLICK, research zoologist, Queens College, New York, for studies of the embryology of the fruit-fly, *Drosophila melanogaster*, with special reference to the cytology and differentiation of the organs and organ systems in the larva.

DR. HORACE ALBERT BARKER, assistant professor and assistant soil microbiologist, University of California, for researches in the field of bacteriological biochemistry.

DR. ISRAEL LYON CHAIKOFF, associate professor of physiology, University of California, for investigations with radioactive phosphorus and iodine as indicators of metabolic processes in animals and for the preparation of a monograph on the physiological and biochemical aspects of the lipid metabolism.

DR. JOHN THOMAS MEDLER, entomologist, Ruidoso, New Mexico, for an investigation of the nutritional requirements and the chemistry of salivary secretions of certain insects.

DR. ERNST CLEVELAND ABBE, associate professor of botany in the University of Minnesota, for the continuation of his researches on the bearing of historical, climatic and geological factors on the vegetation of a heavily glaciated region in the eastern subarctic.

DIETRICH BODENSTEIN, who is a technician in the biological laboratory of Stanford University, for investigations into the problem of metamorphosis in insects.

DR. WILLIAM CHRISTIAN KRUMBHIN, assistant professor of geology, University of Chicago, will investigate the dynamical processes by which sedimentary particles are abraded, changed in shape and sorted into the deposits found in nature.

DR. GEORGE PRIOR WOOLLARD, geophysicist, Princeton, New Jersey, will make seismic, gravitational and magnetic investigations of the geologic structure underlying the North American Atlantic coastal plain.

DR. SOLOMON E. ASCH will prepare a book on the formation and change of opinion and attitude.

DR. EDWARD GIRDEN will make a comparative investigation of the neuropsychological determinants of the phenomena of dissociation.

DR. GEORGE KATONA, of New York City, will continue his studies in the field of the psychology of learning.

DR. RUDOLF ARNHEIM, a refugee psychologist from Germany, will study the application of the principles and methods of Gestalt psychology to art analysis.

DR. VOLNEY COLVIN WILSON, instructor in physics, University of Chicago, a study of the development of machinery for the production of high energy x-rays.

DR. WILSON MARCY POWELL, assistant professor of physics, Kenyon College, Gambier, Ohio, cosmic ray research, in particular a cloud-chamber study of the abundance and energy distribution of slow protons and mesotrons at high altitudes.

DR. WILLARD FRANK LIBBY, assistant professor of chemistry, University of California, studies in physical chemistry, with particular reference to application of the methods of nuclear physics.

DR. VERNER FREDERICK HENRY SCHOMAKER, senior research fellow, California Institute of Technology, studies in the field of molecular spectroscopy.

The trustees of the foundation, in addition to its founders, Senator and Mrs. Simon Guggenheim, are Francis H. Brownell, Carroll A. Wilson, Charles D. Hilles, Roger W. Straus, Charles Earl, John C. Emission and Medley G. B. Whelpley. The committee of selection consisted of Dr. Frank Aydelotte, director of the Institute for Advanced Study, *Chairman*; Dr. Florence R. Sabin, of the Rockefeller Institute for Medical Research; Professor Edwin Bidwell Wilson, of the School of Public Health of Harvard University; Professor Linus Pauling, of the California Institute of Technology, and Professor Wallace Notestein, of Yale University.

The fellows chosen this year come from twenty-three states and three Canadian provinces and are on the staffs of thirty-one educational institutions. The University of California at Berkeley leads with six members of its faculty appointed to fellowship. No other university faculty received more than two appointments.

In addition to these fellowships twenty fellowships were awarded later to Latin American scholars and artists in the twelfth annual Latin American Fellowship competition. All these fellows will work in the United States, and fourteen fellows from the United States will work in various parts of Latin America during the year. The stipend of the Latin American fellowships is usually \$2,000 for a year's fellowship. The twenty fellowships awarded this year are distributed as follows: eight to Brazil, four to Mexico, three to Argentina, two each to Uruguay and Puerto Rico and one to Chile. The Committee of Selection consisted, in addition to Dr. Aydelotte, *chairman*, of Dr. Thomas Barbour, director of the Museum of Comparative Zoology, Harvard University, Dr. Percival Bailey, professor of neurology and neurosurgery, University of Illinois Medical School; Dr. Américo Castro, professor of Spanish, Princeton University, and Dr. Elmer Drew Merrill, professor of botany and director of Botanical Collections, Harvard University. In making their selections, this committee was assisted by many eminent Latin American scholars and authorities in the fields of the applicants' work.

This year's list contains the largest number of Latin American fellowships ever awarded by the foundation in any one year. With the eighty-five fellowships awarded to citizens of the United States and Canada, it brings the total number of fellows assisted by the Foundation this year to one hundred and five. The largest group of the new fellows will work in medical fields. They are:

DR. ANÍBAL SILVEIRA, neurologist at the Juqueri Hospital in São Paulo, Brazil. He will study the electrical activity of the cortex of the brain and its variations under pathological conditions. Another neurologist who has been awarded a fellowship is Dr. NILSON TORRES DE REZENDE, of Pernambuco, Brazil, who will continue his investigations in the field of neuro-physiology.

Two fellows will work in collaboration with Dr. George W. Corner, director of the Laboratory of Embryology of the Carnegie Institution, in Baltimore. They are: DR. WASHINGTON BUÑO, head of the laboratory of histology, Institute of Endocrinology, Montevideo, Uruguay. Dr. Buño will conduct research into certain problems in the field of primate embryology, and DR. LUIS VARGAS FERNÁNDEZ, assistant head of the department of experimental medicine of the National Health Service, Santiago, Chile, who will carry on experimental studies in the field of endocrine pathology.

Also to further their work in endocrinology, the following fellows will come to the United States: DR. JOSÉ RIBEIRO DO VALLE, Professor in the São Paulo School of Medicine and assistant at the Butantan Institute; DR. AMÉRICO SANTIAGO ALBRIEUX MURDOCH, head of the section of endocrinology in the Institute of Endocrinology, Montevideo.

For work in biochemistry the following, both of whom are members of the staff of the Biological Institute of São Paulo, have been appointed: DR. MAURICIO ROCHA E SILVA, member of the staff, São Paulo Biological Institute, who will work at the Rockefeller Institute for Medical Research; DR. OTTO GUILHERME BIER, assistant chief, department of serology, São Paulo Biological Institute, who will make quantitative chemical studies of immunity phenomena in collaboration with Dr. Michael Heidelberger, at the College of Physicians and Surgeons, Columbia University, and DR. EFREN CARLOS DEL POZO, professor of physiology, National School of Biological Sciences, Mexico, will carry on studies of the electrical stimulation of muscle at the Harvard Medical School.

In engineering sciences the following fellowships were awarded: DR. AUGUSTO JOSÉ DURELLI, engineer, Buenos Aires, who will investigate the photoelastic method of determining stresses and the application of this method to practical problems in reinforced concrete design, at the Massachusetts Institute of Technology; and NABOR CARILLO FLORES, professor of mathematics in the National University of Mexico, who will continue his studies of soil mechanics in its application to the construction of foundations of buildings and dams, at Harvard University.

For researches in physics two fellowships were awarded: DR. MARIO SCHENBERG, professor of physics, University of São Paulo, who will study the application of nuclear and atomic physics to astrophysics, and FACUNDO BUESO-SANLLEH, professor of physics, University of Puerto Rico, who will continue his studies in the field of band spectra, with Professor Arthur H. Compton at the University of Chicago.

Three fellows will work on botanical problems: JUAN IGNACIO VALENCIA, of the Darwin Botanical Institute, Buenos Aires, who will continue his taxonomic and mor-

phological studies of South American forage plants in collaboration with Dr. Agnes Chase at the United States National Museum; AGESILAU ANTONIO BITANCOURT, sub-director of the São Paulo Biological Institute, who will make a study of the virus diseases of citrus and of fungus parasites on other economic plants, with Dr. H. S. Fawcett at the Citrus Experiment Station of the University

of California, Riverside, and with scholars in the U. S. Department of Agriculture, and EDGARD DO AMARAL GRANGER, technical assistant in the Institute of Agronomy and lecturer in the "Luiz de Queiroz" School of Agriculture, Piracicaba, Brazil. His project is to study the cytogenetics of corn and tobacco chiefly with Professor T. H. Goodspeed, at the University of California.

## SPECIAL ARTICLES

### THE ORIGIN OF THE RETE APPARATUS IN THE OPOSSUM

THE system of male genital ducts in vertebrates is mainly derived from mesonephric structures, preserved and readapted to another function. The mesonephric duct and a number of anterior tubules become the ductus deferens and ductus epididymidis, and the epididymal tubules, respectively; while connection with the gonad is established by means of the rete elements, which occupy an intermediate position at the hilum. These elements typically anastomose freely in the hilar region but connect as discrete ductules with the prospective epididymal tubules at the glomerular capsules.

While there is agreement as to the development of ductus deferens and epididymis, the problem of the origin of the rete apparatus has received many answers. Historically, it has been derived, according to different studies, from (1) cord-like outgrowths of the glomerular capsules which penetrate the hilum of the gonad to unite with the medullary cords; (2) conversely, by extensions of the medullary cords through the mesorchium to unite with the capsules; (3) as an independent, local development at the hilum, with connections established secondarily in both directions. Considering the diversity of forms studied, the differences of opinion are not surprising. The extensive literature is best approached through the medium of recent general discussions.<sup>1, 2, 3</sup>

In *mammals* the problem is complicated by the rudimentary nature and transitory development of certain of the structures involved. Consequently, if we accept for the purpose of this discussion the prevailing view that the rete apparatus has an independent origin locally, we still encounter widely different opinions as to the nature and precise manner of origin of the earliest visible primordia. One view of doubtful value holds merely, (a) that the rete connections arise as local condensations from the primary mesenchyme; a second (b) derives them from an ill-organized cellular

blastema, probably originating from the adjacent coelomic epithelium;<sup>4, 5, 6, 7, 8</sup> while a third opinion (c) asserts a highly specific origin from discrete epithelial cords (sometimes tubular ingrowths) arising from the coelomic epithelium of the anterior genital ridge.<sup>4, 9, 10, 11</sup> In the last category, the resemblance which these structures bear to abortive nephrostomes or nephrostomial canals is frequently noted and discussed; however, only one author without hesitation describes them as such.<sup>10</sup> If this interpretation is correct there is a considerable accumulation of evidence from a number of mammals placing this group in line with a condition clearly established in certain lower vertebrates.<sup>12, 13</sup> This view would also identify the rete system with other parts of the male duct system, as a transformed mesonephric structure.

Much the same problem exists regarding the origin of the Mullerian duct, in particular the ostial ingrowth. In selachians this duct is still held to arise by a gradual backward splitting of the Wolffian duct, but in higher classes it develops by invagination of a localized area of ciliated coelomic epithelium at the anterior pole of the mesonephros. The ostium thus formed gives rise to the remainder of the duct by backward growth. The invaginating epithelium has been frequently, if rather loosely, identified with one or more mesonephric (or pronephric) nephrostomes.<sup>2, 3, 4</sup>

In view of the interest attaching to these structures, from the standpoint of comparative morphology as well as embryology, their development in the North American opossum (*Didelphys virginiana*), a primitive type of marsupial, deserves description. The process is similar to that described by Fraser<sup>11</sup> for certain Australian marsupials (especially *Trichosurus*),

<sup>4</sup> S. E. Wichmann, *Anat. Hefte*, 45: 629, 1912.

<sup>5</sup> W. Felix, Keibel and Mall, "Manual of Human Embryology," II, Phila.: Lippincott, 1912.

<sup>6</sup> H. M. de Burlet and H. S. de Ruiter, *Anat. Hefte*, 59: 321, 1921.

<sup>7</sup> C. S. Simkins, *Acta Zool.*, 4: 241, 1923.

<sup>8</sup> K. W. Wilson, *Contr. Emb. Carnegie Inst. Wash.*, 17: 69, 1926.

<sup>9</sup> B. M. Allen, *Am. Jour. Anat.*, 3: 89, 1904.

<sup>10</sup> F. W. R. Brambell, *Proc. Roy. Soc., Series B*, 102: 206, 1928.

<sup>11</sup> E. A. Fraser, *Jour. Anat.*, 53: 97, 1919.

<sup>12</sup> A. Brachet, "Traité d'Embryologie des Vertébrés," Paris, 1921.

<sup>13</sup> B. M. Allen, *Am. Jour. Anat.*, 5: 79, 1905.

<sup>1</sup> B. H. Willier, "Sex and Internal Secretions," 2nd Ed. Baltimore: Williams and Wilkins, 1939.

<sup>2</sup> F. W. R. Brambell, "The Development of Sex in Vertebrates," London: Sidgwick and Jackson, Ltd., 1930.

<sup>3</sup> E. S. Goodrich, "Studies on the Structure and Development of Vertebrates," London: Macmillan, 1930.

and to the brief outline given for *Didelphys aurita* by the same author; however, the clear-cut relationship of the rete cords to the coelomic epithelium, and the characteristics which relate them to nephrostomial canals, are particularly distinct in *Didelphys virginiana*.<sup>14</sup> The account that follows is a brief recapitulation, emphasizing features that are especially clear in the material. A full account will appear elsewhere at a later date.

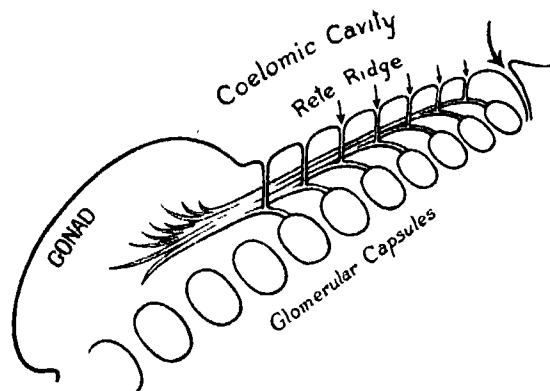
At birth the genital ridge (as in *Trichosurus*) is already distinctly marked off into an anterior region, the *rete ridge*, slender and virtually lacking in germ cells, and a posterior *gonad region*. The latter is still sexually undifferentiated save in exceptional cases. Both gonad and rete ridge are closely applied to the ventro-medial surface of the mesonephros, in intimate relation with a series of glomerular capsules. Within the rete ridge appear numerous irregular epithelial cords, frequently in contact with one another and with the capsules. At intervals these cords are seen to reach the surface of the ridge, where they are continuous with the covering coelomic epithelium. Frequently they appear tubular even at this early stage.

Development is slow for a time, but by 10 days, when the gonads are well differentiated, the cords within the ridge form a compact bundle of rete canals, lined with a densely staining epithelium. Toward the hilum of the gonad they merge gradually into a single large duct; toward the mesonephros they diverge as discrete tubules which unite individually with glomerular capsules. The primitive connections with the coelomic epithelium are now wide, funnel-like canals (6-8 typically) lined with the same massive epithelium, which also spreads over the surface of the ridge, with an abrupt transition to mesothelium of ordinary coelomic type. Longitudinally, this epithelium forms an irregular band along the crest of the ridge, and is continuous at the anterior end of the ridge with the ostium of the Mullerian duct. It is during this period that the Mullerian duct is developing. The plan and relationships of the system, at the height of its development, are shown in Fig. 1.

At twelve to fourteen days a sex difference is usually found, although there is great variability. In most males the funnel-like ducts joining the rete canals with the coelom, are retrogressing. In some specimens they have virtually disappeared, but may be seen in others as late as twenty days. In females they remain open indefinitely and at seven weeks still retain their original relationships, opening on the surface of the mesovarium in continuity with the fimbriated margin of the ostium.

Thus in males the rete canals, in adaptation to their eventual function, lose their primary communications with the coelom comparatively early. In the female

they remain open indefinitely, and the rete itself persists as a well-developed structure in the adult ovary. It has been shown that male hormones evoke this sex difference in females by effecting early closure of the



PLAN OF THE RETE APPARATUS IN *DIDELPHYS VIRGINIANA*

FIG. 1. Plan of the rete system in *Didelphys virginiana*; a composite of conditions encountered between 10 and 20 days, pouch life. The large arrow indicates the ostium of the Mullerian duct, small arrows coelomic funnels of the rete canals.

funnels, with development of a rete and epididymis comparable with the normal male parts.<sup>15</sup>

#### SUMMARY AND CONCLUSIONS

The rete apparatus in the opossum appears first as a series of cellular cords, or slender canals, arising from an irregular band of thickened coelomic epithelium covering the rete region of the genital ridge. At the cephalic end of the ridge this band is directly continuous with and indistinguishable from the area that gives rise to the ostium tubae. A number of these cords become canalized and appear as wide, funnel-like openings leading from the body cavity into the rete canals, which are now also tubular. During the period when the funnels are becoming patent the ostial invagination is also developing. In males the funnels retrogress early, converting the rete canals into closed passages, while the ostium tubae also atrophies. In females, in which the ostium is a functional structure, the rete invaginations also remain open indefinitely.

From the manner of origin and early relationships of these canals, from their appearance at the height of differentiation, and from their behavior during later development, it is strongly indicated that, together with the ostial invagination, they represent a series of persistent nephrostomial canals. Thus the rete canals, like other parts of the male genital duct system, are derived from preexisting mesonephric structures, while

<sup>14</sup> R. K. Burns, Jr., *Anat. Rec.*, 79 (Supplement), 1941.

<sup>15</sup> R. K. Burns, Jr., *Jour. Morph.*, 69: 79, 1939.

the individual rete invaginations and the ostial funnel are morphologically members of a homologous series.

R. K. BURNS, JR.

CARNEGIE INSTITUTION OF WASHINGTON,  
BALTIMORE

### ARGINASE

ARGINASE as compared with the starting material—a watery extract from ground beef liver—was purified 50 times, using the common protein separation methods. The ferment solution obtained showed absence of catalase, amylase and proteolytic enzymes. Spectroscopic examination revealed the absence of hemoglobin, myoglobin and cytochrome C.

10% of this protein solution hydrolyzed 30 to 35 per cent. of 17.4 mg arginine within 10 minutes under the condition of the experiment.

While the addition of  $Mn^{++}$ -ions<sup>1</sup> to a crude liver extract is frequently without any effect upon the activity of the enzyme, it was found that in the further stages of purification  $Mn^{++}$ -ions are essential for obtaining maximum activity of the enzyme. The activation of arginase by metallic ions, for instance,  $Mn^{++}$ , is a time reaction requiring about 15 minutes under the condition of the experiment for obtaining optimum activation. The optimum pH for the purified enzyme (with or without  $Mn^{++}$ -ions) is about 9.5. Other ions, such as  $Fe^{++}$ ,  $Ni^{++}$  and  $Co^{++}$  also activate the enzyme but to a less extent than  $Mn^{++}$ . Here again, however, the optimum pH for these ions was found to be about 9.5.

Arginase (no addition)	.35
“ + $Mn^{++}$	.71
“ + $Mn^{++}$ —vitamin C	.71
“ + $Co^{++}$	.53
“ + $Co^{++}$ —vitamin C	.56
“ + $Ni^{++}$	.50
“ + $Fe^{++}$	.48
“ + $Fe^{++}$ —cysteine	.59

10% arginase; 17.4 mg arginine; heavy metal salts 0.5%; vitamin C or cysteine 1%; total volume 1.5 cc adjusted to pH 9.5; incubated for 10 minutes at 37.5° C. Numbers are n/20 KOH. Method of determination was the Linderstroem-Lang method<sup>2</sup> for titration of ornithine, modified to semi-micro.

In the purified state arginase is quite stable, tolerating dialysis for 48 hours at 4° C. without loss of activity. The ferment solution is also stable at this temperature for weeks and its activity not altered by evaporating from the frozen state to dryness and subsequent redissolving.

The isoelectric point of the enzyme was found by electrophoresis to be at pH 5.7. The investigation of the ash content of the purified enzyme gave in one case an Mn-content of 0.08 per cent.

<sup>1</sup> G. Klein and W. Ziese, *Klin. Woch.*, 14: 205, 1935.

<sup>2</sup> K. Linderstroem-Lang, L. Weil and H. Holter, *Z. physiol. Chem.*, 233: 174, 1935.

The investigation was supported financially by a Rockefeller grant.

RENATE JUNOWICZ-KOCHOLATY<sup>3</sup>

WALTER KOCHOLATY<sup>3</sup>

UNIVERSITY OF CHICAGO

### THE INDUCTION OF FERTILITY IN GENETICALLY SELF-STERILE PLANTS

In hybridization experiments designed for the production of new colors in the various classes of commercially important Petunias, a strain of Golden Rose was discovered that has been found to be completely self-sterile under natural conditions. The self-sterility in this strain of Petunia behaves in inheritance as a simple Mendelian recessive character. By means of cuttings the strain has been maintained in the Botanical Laboratory of Bucknell University for the past five years. The plants are unusually floriferous and everblooming, due, in part at least, to their inability to produce seeds unless they receive pollen from plants which are not homozygous recessive for the self-sterility gene. Although many thousands of flowers were produced during this period and although repeated attempts were made to self-fertilize the plants, not a single seed capsule was ever produced until recently when self-fertility was induced by the techniques described below.

Dr. H. Clyde Eyster, of the Botany Department of the University of South Dakota, made microscopic observations of the pollen tubes in the stigmas and styles of the self-pollinated self-sterile plants and found that the pollen grains germinate well and develop into tubes which extend into the neck of the style but rarely if ever grow as far as one half the distance from the stigma to the ovary. In styles that had been cut three days after they had been self-pollinated, Dr. Eyster found that most of the pollen tubes grow only about one tenth of the distance from the stigma to the ovary, while an occasional tube grows somewhat less than one half of the distance down the style. Before any of the tubes reach the ovary, the style is cut off from the top of the ovary by the formation of an abscission layer. From these observations it appears that the self-sterility in the Golden Rose Petunia studied is caused by the very slow rate of growth of the pollen tubes and the formation of an abscission layer which severs the style from the ovary before any of the tubes enter the latter.

The pollen of the self-sterile plants was placed on the stigmas of normal self-fertile plants and allowed to develop for forty-eight hours. At the end of this time the styles were cut, preserved and sent to Dr. Eyster for microscopic examination. Approximately 75 per cent. of the pollen grains were found to have developed pollen tubes of varying lengths, including many which extended all the way down the style and,

<sup>3</sup> Now at the University of Pennsylvania.

presumably, into the ovary. This result was to be expected since the pollen of the self-sterile plants causes normal seed pods with viable seeds to be produced on plants which are not homozygous recessive for the gene for self-sterility involved. So also the pollen of plants which are not homozygous recessive for the self-sterility gene develops normally in styles of the self-sterile plants. Observations of styles made forty-eight hours after they had been pollinated showed that from 75 to 95 per cent. of the pollen had germinated and had formed tubes of varying lengths, including many which extended all the way down the style.

Plants of the self-sterile strain of Golden Rose *Petunia* can be self-fertilized by either of two methods described below: If flower buds which are beginning to develop anthocyanin in the petals, are opened and pollinated with pollen from fully opened flowers from the same plant, seed capsules containing viable seeds are produced. Similar results were found in *Petunia violacea* by Yasuda,<sup>1</sup> who refers to this method of self-fertilization as homo-pollination. In a more recent study Yasuda<sup>2</sup> found that the placenta in the ovary of *Petunia violacea* secretes a "special substance" which diffuses into the style and retards or completely inhibits the germination of the pollen and the development of pollen tubes. Preliminary studies with the self-sterile Golden Rose strain of *Petunia* in my laboratory indicate that when the sap expressed from the ovary of self-sterile plants is placed on the stigma and style of strains which are not homozygous recessive for the self-sterility gene, the latter strains are rendered cross-sterile with the self-sterile plants. This result tends to show that the ovarian secretion

which renders the plant self-sterile can be transferred to other plants and renders them cross-sterile with pollen from self-sterile plants.

✓ The self-sterile plants can also be made self-fertile in a more simple and more remarkable manner. This may be accomplished by spraying the flowering plants with a solution composed of ten parts of alpha naphthalene acetamide dissolved in one million parts of water.<sup>3</sup> Flowers which are sprayed with this solution immediately before or shortly after they have been self-pollinated produce seed capsules filled with viable seeds in exactly the same way that normal self-fertile plants of other strains produce seeds. Obviously alpha naphthalene acetamide neutralizes the effects of the ovarian secretion which diffuses into the style and inhibits or greatly retards the growth of the pollen tubes. Seeds from such self-fertilized self-sterile plants were found, when planted, to grow into normal seedlings and the per cent. of germination in all trials was unusually high.

Preliminary experiments indicate that the alpha naphthalene acetamide greatly increases the self-fertility or self-compatibility of highly inbred and highly sterile strains of *Tagetes erecta* (African marigolds), *Brassica oleracea* (cabbage) and *Trifolium pratense* (red clover). These results suggest that a great variety of economically important plants which are normally partly or completely self-sterile or self-incompatible may be made self-fertile by the use of a suitable solution of alpha naphthalene acetamide as indicated in the preliminary report given in this paper.

WILLIAM H. EYSTER

BUCKNELL UNIVERSITY

## SCIENTIFIC APPARATUS AND LABORATORY METHODS

### A NEW PROCEDURE FOR ADSORPTION ANALYSIS

If a liquid containing one or more dissolved substances is allowed to pass slowly through a layer of a finely divided adsorbent, the different solutes, dependent upon the degree of adsorption, will become more or less retarded as compared to the liquid. If the solution flows upwards through the adsorbent and emerges into a vessel suitable for optical observation (for example, by the Toepler Schlieren method, as used in observations of electrophoretic migration<sup>1</sup>) a number of boundaries will be observed, corresponding to the number of differently adsorbable components

present, and the volume of liquid between each boundary and the meniscus ("the retardation volume") will equal the ratio between the amount adsorbed and the concentration of the corresponding component.

If the mutual adsorption displacement effects are negligible the concentrations of the components in the observation tube should have the same value as in the original solution. A new method for qualitative and quantitative analysis, with a very wide field of application, may be based upon the principle described. A theoretical treatment and a description of the experimental arrangement has been given in two recent communications.<sup>2</sup> The method has been tried on mixtures

<sup>1</sup> Sadawo Yasuda, *Proc. Crop. Sci. Soc. Japan*, 2 (2): 122-126, 1930.

<sup>2</sup> Sadawo Yasuda, *Bot. Mag. (Tokyo)*, 46 (548): 510-517, 1932.

<sup>3</sup> A. Tiselius, *Trans. Farad. Soc.*, 33: 524, 1937. See also *The Harvey Lectures*, 35: 37, 1939-40.

<sup>1</sup> The alpha naphthalene acetamide was used in the form of the commercial preparation known as Fruitone.

<sup>2</sup> A. Tiselius, *Arkiv för Kemi (Royal Swedish Academy of Sciences)*, 14 B, No. 22 and No. 32. A detailed description of the method and some of its applications is to appear this year in "Advances in Colloid Science," edited

of various substances; for example, saccharides, organic acids in water or organic solvents, and some

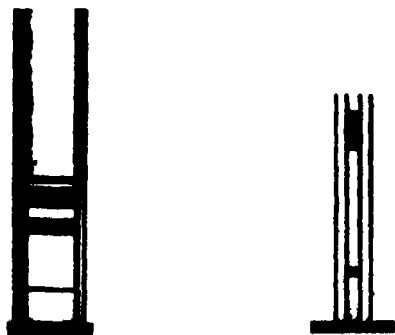


FIG. 1. Schlieren photographs of adsorption analysis. *Left*: 1 per cent. NaCl, 1 per cent. glucose, 1 per cent. lactose. Cross-section of cuvette 100×20 mm. *Right*: 1 per cent. NaCl, 1 per cent. glucose (the meniscus has passed out of the field of vision). Cross-section of cuvette 50×5 mm.

stereoisomeric compounds. Fig. 1 shows a photograph obtained by the Schlieren method on a mixture of 1 per cent. sodium chloride, 1 per cent. glucose and 1 per cent. lactose, and Fig. 2 a gradient curve (photographed by the Philpot-Svensson modification of the Schlieren method) from an experiment on (left to

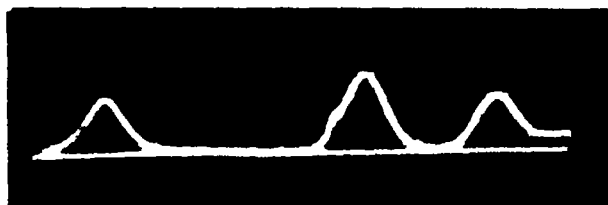


FIG. 2. Gradient curve photographs of adsorption analysis. *Left to right*: 0.5 per cent. leucine, 0.5 per cent. valine, 0.5 per cent. alanine.

right) 0.5 per cent. leucine, 0.5 per cent. valine and 0.5 per cent. alanine. The active carbon used in these experiments was packed into a cylindrical cell 20 mm in diameter and 10 mm in height between filter paper supported by perforated disks, and this cell is attached to the bottom of an optical cuvette with 50×5 mm cross-section area.

In Fig. 3 the retardation volumes per gram active carbon have been plotted for 0.5 per cent. solutions of a number of amino acids and peptides. The first two rows were obtained in neutral solutions with "Carbo Active Kahlbaum" the last row in alkaline and acid buffer solutions on "Eponit 3n" of the Lurgi G.m.b.H.

Adsorption displacement effects in mixtures tend to make the observed concentrations too large for the less adsorbable components. To avoid this one should try to choose the conditions such as to give relatively

small occupation of the available adsorbing surface area. Thus, low concentrations, or extreme pH-values at which the adsorption is considerably diminished are to be preferred. Eventually one may extrapolate to zero from two determinations at different total con-

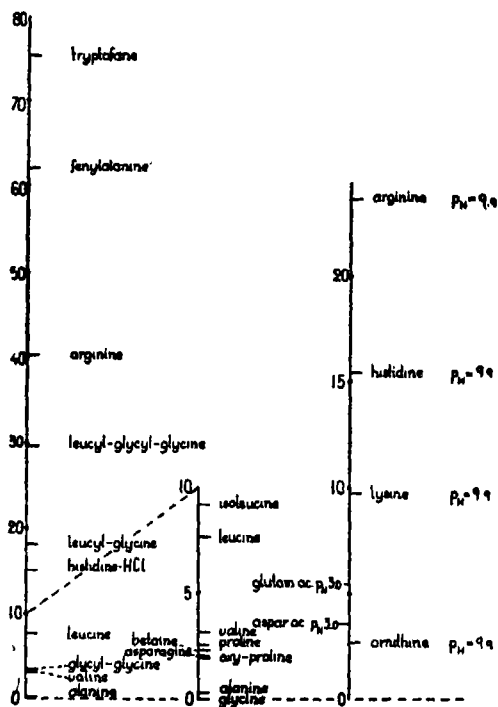


FIG. 3. Specific retardation volumes ( $\text{cm}^3$  per gram adsorbent) for 0.5 per cent. solutions of some amino acids and peptides.

concentrations. Concentration determinations on the successive layers are made on samples collected in a container on top of the observation cuvette, or may be obtained by integration of the gradient curves (Fig. 2).

The method described is obviously a modification of the Tswett chromatographic analysis, but it is not limited to colored substances and is easier to adapt for quantitative work.

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## BOOKS RECEIVED

- DRINKER, CECIL K. and JOSEPH M. YOFFEY. *Lymphatics, Lymph and Lymphoid Tissue; their Physiological and Clinical Significance*. Harvard University Monograph in Medicine and Public Health No. 2. Pp. ix + 406. 50 figures. Harvard University Press. \$4.00.
- LLOYD-JONES, ESTHER and RUTH FREDER. *Coming of Age*. Pp. x + 280. Whittlesey House, McGraw-Hill. \$3.50.
- RITCHIE, JOHN W. *Biology and Human Affairs*. Pp. xiv + 1026. Illustrated. World Book Company. \$2.32.
- WILLIAMS, ROGER J. *An Introduction to Organic Chemistry*. Fourth edition. Pp. xiii + 628. Van Nostrand. \$4.00.

by E. O. Kraemer (Interscience Publishers, Inc., New York).

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## THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

### PRELIMINARY ANNOUNCEMENT OF THE FIFTH CHICAGO MEETING

By Dr. F. R. MOULTON

PERMANENT SECRETARY

FROM September 22 to September 27, inclusive, the association will join with The University of Chicago in celebrating the fiftieth anniversary of its founding. The university has organized a program of addresses by distinguished scientists and scholars and an extensive series of symposia in the fields of the natural sciences and the humanities under the general title "New Frontiers in Education and Research." Outlines of the programs of these addresses and symposia were published in the July 4 issue of SCIENCE, pages 20-22.

This is the fifth meeting of the association in Chicago. The earlier meetings were held in 1868, 1908,

1920 and 1933, the latest in connection with the Century of Progress Exposition organized in celebration of a century of progress through science. The theme of the exposition was proposed by Dr. Michael I. Pupin, president of the association in 1925.

Persons attending the meeting in Chicago may arrange for convenient living accommodations in the Residence Halls of the university by writing the Director of the Fiftieth Anniversary Celebration for reservations. It is suggested that those desiring rooms on the university campus write promptly (not later than August 25) for reservations because the number that will be available is limited. Each applicant

should state precisely the period for which accommodations are desired. The rates are \$2.00 per day for room and breakfast or \$3.00 per day for room and all meals. There are several residence hotels within easy reach of the university, the principal ones being the Chicago Beach, the Del Prado, the Shoreland, the Windermere, the Aragon, the Broadview, the Fairfax, the Flamingo, the Hyde Park, the Plaisance and the Sherry, which can accommodate limited numbers of guests at minimum rates of \$2.50 to \$3.50 for single room and bath and of \$3.00 to \$5.00 for double room and bath. Reservations should be made directly with the hotels.

It is important, too, that all persons expecting to attend the celebration should inform the university not later than August 25 for which of the symposia they desire to register.

Since the university is about seven miles from the railroad passenger terminals near the center of the city, those arriving over eastern, southern and southwestern railroads should leave their trains at suburban stations on Sixty-third Street. The university may be conveniently reached from downtown Chicago by Illinois Central suburban trains, the downtown stations of which are east of Michigan Avenue in the direction of Lake Michigan.

#### HEADQUARTERS AND MAIL

Headquarters for the meeting will be in Ida Noyes Hall on the university campus. Persons attending the meeting should register (without charge) so that there will be a record of their local addresses for convenience in distributing mail and for use in getting into contact with them. Programs of the meeting will be distributed at the headquarters.

#### GENERAL SESSIONS

At each of its meetings, the association holds several general sessions at which distinguished scientists discuss subjects of wide interest. A number of such sessions have been arranged for, all except one by the university. Since they have already been announced in the July 4 issue of *SCIENCE*, page 22, a brief résumé of them will be sufficient. They begin on Monday afternoon, September 22, and continue through Friday, September 26.

The subjects of the general addresses are: (Monday) The Social Implications of Vitamins, by Dr. Robert R. Williams; (Tuesday) The Physiology of the Amino Acids, by Dr. Donald D. Van Slyke; (Wednesday) Spinors and Projective Geometry, by Dr. Oswald Veblen; Some Unsolved Problems of Theoretical Dynamics, by Dr. George D. Birkhoff; Textile Research in the Interest of the Consumer, by Dr. Ruth O'Brien; (Thursday) Tuberculosis as the

Chemist Sees It, by Dr. Florence B. Seibert; Glaciation and Submarine Valleys, by Dr. Reginald A. Daly; Advancing Frontiers in Nursing Education, by Dr. Isabel M. Stewart; The Historical Interpretation of Art and Literature, by Halvdan Koht; (Friday) Nuclear Transformations, by Dr. Ernest O. Lawrence; The Cosmical Abundance of the Elements, by Dr. Henry Norris Russell; The Significance of Choline as a Dietary Factor, by Dr. Charles H. Best; and Virus Infection of the Mammalian Foetus, by Dr. Ernest W. Goodpasture.

#### SYMPOSIA PROGRAMS

For the convenience of members of the association, the symposia programs will be listed on the basis of their subjects in the order, so far as is possible, of the sections of the association.

#### SECTION ON MATHEMATICS (A)

Under the joint auspices of the section, the American Mathematical Society and the Mathematical Association of America, the annual Josiah Willard Gibbs Lecture will be delivered on September 3, by Sewall Wright, The University of Chicago, on "Statistical Genetics and Evolution." For further information about the programs of the societies, which meet in Chicago on September 2 to 6, see the July 11 issue of *SCIENCE*, page 36.

The section and the two affiliated mathematical societies sponsor the general session on Wednesday, September 24, at which Drs. Oswald Veblen and George D. Birkhoff will deliver addresses, the former on "Spinors and Projective Geometry" and the latter on "Some Unsolved Problems of Theoretical Dynamics."

#### SECTIONS ON PHYSICS (B) AND ASTRONOMY (D)

*Cosmic Rays.* Friday, September 26.

Contributors: Robert A. Millikan, California Institute of Technology; William P. Jesse, Marcel Schein and Ernest O. Wollan, The University of Chicago; Bruno Rossi, Cornell University; S. Chandrasekhar, The University of Chicago.

#### SECTION ON CHEMISTRY (C)

*Organic Chemistry.* Monday-Tuesday, September 22-23.

Contributors: William A. Noyes, Jr., University of Rochester; James Franck, The University of Chicago; Louis P. Hammett, Columbia University; Frank H. Westheimer, The University of Chicago; Linus C. Pauling, California Institute of Technology; George W. Wheland, The University of Chicago; Lawrence O. Brockway, University of Michigan; Simon H. Bauer, Cornell University; Francis O. Rice, Catho-

lie University of America; Morris S. Kharasch, The University of Chicago.

*Surface Chemistry.* Tuesday–Wednesday, September 23–24. In honor of Dr. William D. Harkins on the twenty-fifth anniversary of the publication of his first paper in the field.

Contributors: Fritz London, Duke University; William D. Harkins, The University of Chicago; John G. Kirkwood, Cornell University; Henry Eyring, Princeton University; Eugene Guth, University of Notre Dame; Henry B. Bull, Northwestern University Medical School; George H. A. Clowes, Eli Lilly and Company; Eli F. Burton, University of Toronto; Irving Langmuir and Vincent J. Schaefer, General Electric Company; George E. Boyd, The University of Chicago; Ernst A. Hauser, Massachusetts Institute of Technology; Adrian J. Grossman.

#### SECTION ON GEOLOGY AND GEOGRAPHY (E)

*Frontiers of Knowledge in the Geologic Sciences.* Thursday–Friday, September 25–26.

Leaders of discussions: Ralph E. Grim, Gilbert H. Cady, Illinois Geological Survey; Richard F. Flint, Yale University; A. I. Levorsen, Research Committee of the American Association of Petroleum Geologists.

#### SECTIONS ON THE ZOOLOGICAL SCIENCES (F) AND THE BOTANICAL SCIENCES (G)

*The Respiratory Enzymes and the Biological Actions of the Vitamins.* Thursday–Saturday, September 11–13, at Madison, Wisconsin, Monday–Wednesday, September 15–17, at Chicago, under the joint sponsorship of The University of Chicago and the University of Wisconsin. For information and reservations address Dr. T. R. Hogness, The University of Chicago.

*The Training of Biologists.* Thursday–Saturday, September 18–20. For information and reservations address Dr. Paul A. Weiss, The University of Chicago.

*Growth and Differentiation in Plants.* Ezra J. Kraus, The University of Chicago, *chairman*. Monday morning, September 22.

Contributors: Charles E. Allen, University of Wisconsin, John M. Beal, The University of Chicago; Edmund W. Sinnott, Yale University; John W. Mitchell, U. S. Department of Agriculture.

#### SECTIONS ON THE BIOLOGICAL SCIENCES (F, G) AND ON THE SOCIAL AND ECONOMIC SCIENCES (K)

*Levels of Integration in Biological and Social Systems.* Tuesday–Wednesday, September 23–24.

*I. Organismic Aspects.* Warder C. Allee, The University of Chicago, *chairman*.

Contributors: Libbie H. Hyman, American Museum of Natural History; James W. Buchanan, Northwestern University; Ralph W. Gerard, The University of Chicago.

*II. Group of Population Aspects.* William H. Taliaferro, The University of Chicago, *chairman*.

Contributors: William Burrows, The University of Chicago; Herbert S. Jennings, Johns Hopkins University and University of California at Los Angeles; Thomas Park and Warder C. Allee, The University of Chicago.

*III. The Comparative Study of Societies.* Robert Redfield, The University of Chicago, *chairman*.

Contributors: Alfred E. Emerson, The University of Chicago; Clarence R. Carpenter, Pennsylvania State College; Alfred L. Kroeber, University of California; Robert E. Park, The University of Chicago.

#### SECTIONS ON THE BIOLOGICAL SCIENCES (F, G) AND ON THE MEDICAL SCIENCES (N)

*Problems in Aerobiology.* Monday–Tuesday, September 22–23. This symposium, organized by Sections F, G and N, consists of two parts, the first dealing with exterior wind-borne biological units and the second with interior wind-borne biological units. The details of the program will be announced in a later issue of SCIENCE.

#### SECTIONS ON PSYCHOLOGY (I) AND ON THE MEDICAL SCIENCES (N)

*Visual Mechanisms.* Karl S. Lashley, Harvard University, and Selig Hecht, Columbia University, *chairmen*. Wednesday, September 24.

Contributors: Selig Hecht, Columbia University; Arlington C. Krause, The University of Chicago; Ernst Gellhorn, University of Illinois; Heinrich Klüver, The University of Chicago; Theodore J. Case, The University of Chicago; Samuel H. Bartley, Washington University; Stephen Polyak, The University of Chicago; Karl S. Lashley, Harvard University.

#### SECTION ON SOCIAL AND ECONOMIC SCIENCES (K)

*The Public Social Services: Fifty Years of Progress.* Edith Abbott, The University of Chicago, *chairman*. Monday morning, September 22.

Contributors: Helen R. Wright, The University of Chicago; Martha Eliot, U. S. Children's Bureau; Carter Goodrich, Columbia University.

*The Changing Bases of National Economy.* Paul H. Douglas, The University of Chicago, *chairman*. Tuesday morning, September 23.

Contributors: John M. Clark, Columbia University; Frank H. Knight and Theodore O. Yntema, The University of Chicago.

*Management's Adjustment to the Changing National Economy.* William N. Mitchell, The University of Chicago, *chairman*. Tuesday afternoon, September 23.

Contributors: Willard L. Thorp, Dun and Bradstreet, Inc.; Lewis C. Sorrell, Raleigh W. Stone and James W. Young, The University of Chicago.

*Measurement and Experiment.* William F. Ogburn, The University of Chicago, *chairman*. Wednesday afternoon, September 24.

Contributors: Samuel S. Wilks, Princeton University; Louis L. Thurstone, The University of Chicago.

*Civilizations in Transition.* Louis Gottschalk, The University of Chicago, *chairman*. Wednesday afternoon, September 24.

Contributors: Michael I. Rostovtzeff, Yale University; His Excellency Hu Shih, Ambassador of China to the United States; Robert H. Lowie, University of California.

*The Place of Law in Society.* Charles E. Merriam, The University of Chicago, *chairman*. Thursday afternoon, September 25.

Contributors: Robert H. Lowie, University of California; Charles H. McIlwain, Harvard University; Hans Kelsen, University of Vienna and Harvard University.

*The Place of Ethics in Social Science.* John Ulric Nef, The University of Chicago, *chairman*. Friday morning, September 26.

Contributors: Robert Maynard Hutchins, The University of Chicago; Richard H. Tawney (tentative), University of London; Charles H. McIlwain, Harvard University; Jacques Maritain, Catholic Institute of Paris and Columbia University.

*Administrative Agencies—Recommendations of the Attorney-General's Committee.* Wilber G. Katz, The University of Chicago, *chairman*. Saturday evening, September 27.

Contributors: John Foster Dulles, the New York Bar; Walter Gellhorn, Columbia University; John Dickinson, University of Pennsylvania.

#### SECTION ON HISTORICAL AND PHILOLOGICAL SCIENCES (L)

*Approaches to Linguistics.* Clarence E. Parmenter, The University of Chicago, *chairman*. Monday morning, September 22.

Contributors: Edgar H. Sturtevant, Yale University; Amado Alonso, University of Buenos Aires; Clarence H. Faust and Charles W. Morris, The University of Chicago; Vincent J. Flynn, College of St. Thomas; William C. Korfmacher, St. Louis University.

*The Editing of a Text.* William A. Nitze, The University of Chicago, *chairman*. Monday afternoon, September 22.

Contributors: Edward C. Armstrong, Princeton University; Charles H. Beeson and James R. Hulbert, The University of Chicago; Gustave O. Arlt, University of California at Los Angeles; Rae Blanchard, Goucher College; William Roach, University of Pennsylvania.

*Interpretation and Criticism of Art and Literature.* Ronald S. Crane and Ulrich A. Middeldorf, The University of Chicago, *chairmen*. Tuesday, September 23.

Contributors: Henri Frankfort, The University of Chicago; Charles R. Morey, Princeton University; Lily Bess Campbell, University of California at Los Angeles; G. Haydn Huntley, Robert Vigneron and Norman F. Maclean, The University of Chicago; Van Meter Ames, University of Cincinnati; Bernard Weinberg, Washington University; Elder Olson, Illinois Institute of Technology.

*Philosophic Procedures in the Arts and Sciences.* Richard P. McKeon, The University of Chicago, *chairman*. Wednesday, September 24.

Contributors: Robert L. Calhoun, Yale University; Friedrich Kessler and Frank H. Knight, The University of Chicago; Clarence I. Lewis, Harvard University; Charles Hartshorne, The University of Chicago; George V. Gentry, University of Texas.

*Problems in Historical Materials.* Wilbur K. Jordan, The University of Chicago, *chairman*. Thursday morning, September 25.

Contributors: William L. Westermann, Columbia University; Richard P. McKeon and Bernadotte E. Schmitt, The University of Chicago; Ray W. Frantz, University of Nebraska; Alfred P. Dorjahn, Northwestern University; Loren C. MacKinney, University of North Carolina; Stuart R. Tompkins, University of Oklahoma.

*Archeology as a Tool in Humanistic and Social Studies.* Albert Ten Eyck Olmstead, The University of Chicago, and William L. Westermann, Columbia University, *chairmen*. Friday morning, September 26.

Contributors: Robert L. Engberg, American School for Oriental Research at Jerusalem; Michael I. Rostovtzeff, Yale University; Neilson C. Debevoise, The University of Chicago; Harold R. Willoughby, The University of Chicago; Richard A. Parker, The University of Chicago.

#### SECTION ON THE MEDICAL SCIENCES (N)

*The Theobald Smith Award in Medical Sciences.* Monday afternoon, September 22. Each year at its annual meeting the association determines the recipient of its Theobald Smith Award for the ensuing year. The award consists of a bronze medal and one thousand dollars in cash, provided by the Eli Lilly Company of Indianapolis, Indiana. The recipient

presents a paper and receives the award at the summer meeting of the association following the annual meeting at which it was voted. The recipient of the award for 1941 is Herald R. Cox.

"Cultivation of Rickettsiae of the Rocky Mountain Spotted Fever, Typhus, and Q Fever Groups in the Embryonic Tissues of Developing Chicks," Herald R. Cox, Rocky Mountain Laboratory, Hamilton, Montana.

*Life at High Altitudes and Aviation Medicine.* Anton J. Carlson, The University of Chicago, *chairman*. Tuesday morning, September 23.

Contributors: Carlos Monge, University of San Marcos, Peru; David Bruce Dill, U. S. Army; E. S. Guzmán Barrón, The University of Chicago.

*Thoracic Diseases.* Dallas B. Phemister, The University of Chicago, *chairman*. Thursday morning, September 25.

Contributors: Clayton G. Loosli and William E. Adams, The University of Chicago; Evarts A. Graham, Washington University; John Alexander, University of Michigan; Oswald H. Robertson and Robert G. Bloch, The University of Chicago.

*Sex Hormones.* Frank R. Lillie, The University of Chicago, *chairman*. Friday morning, September 26.

Contributors: Carl R. Moore and Allan T. Kenyon,

The University of Chicago; Edward A. Doisy, St. Louis University; John S. L. Browne, McGill University; Fred C. Koch, The University of Chicago.

*Immunological Mechanisms.* George F. Dick, The University of Chicago, *chairman*. Friday morning, September 26.

Contributors: William Bloom, The University of Chicago; Linus C. Pauling, California Institute of Technology; Thomas M. Rivers, The Rockefeller Institute for Medical Research.

#### THE SECTION ON EDUCATION (Q)

*Environment and Education.* Robert J. Havighurst, The University of Chicago, *chairman*. Monday morning, September 22.

Contributors: Ernest W. Burgess, The University of Chicago; Franz Alexander, Institute for Psychoanalysis, Chicago; W. Lloyd Warner, The University of Chicago; Margaret Mead, American Museum of Natural History.

*The Conceptual Structure of Educational Research.* Guy Thomas Buswell, The University of Chicago, *chairman*. Tuesday afternoon, September 23.

Contributors: Thomas R. McConnell, University of Minnesota; Douglas E. Scates, Duke University; Frank N. Freeman, University of California.

## COLLOIDS IN ASTRONOMY AND METEOROLOGY

By JEROME ALEXANDER

NEW YORK, N. Y.

THE slight, irregular motion of tiny particles approximating the limits of microscopic resolvability was named in honor of Robert Brown, a Scotch botanist, who first drew attention to this phenomenon in 1827. Since non-living particles exhibit Brownian motion, there were many speculations as to its cause. It was often called "pedesis," because the particles seemed to "walk" about, and as early as 1896 Sir William Ramsay connected it up with the kinetic theory by expressing the view that there was a gradual transition between particles in gases or in solution, and particles in suspensions. The discovery of the ultramicroscope in 1903 by Richard Zsigmondy brought visual proof of the correctness of this view, for it brought into *visibility* particles as small as 5  $\mu$  (five millionths of a millimeter). Since such submicroscopic particles are smaller than the wave-lengths of visible light, they can not be resolved, although they may be seen as "points" of varying degrees of luminosity and of Brownian activity. Calculations by Perrin, Einstein, Smoluchowski and others proved that the nature of the motion seen was what the kinetic theory de-

manded for particles of this size. Similarly, in the astronomical field, the discs of the sun and the moon may be resolved visually, and even small telescopes will resolve the larger planets; but not even the most powerful telescopes can resolve any of the fixed stars.

While no natural arbitrary limits exist for particles in what we now term the colloidal state of dispersion, these limits are, roughly, between 100 and 5  $\mu$ ; that is, they begin just about the zone of microscopic resolvability and run down to dimensions commonly attributed to large molecules. It must be emphasized that particle size, that is, degree of subdivision or dispersion, is the criterion for colloidity, and that consequently, any substance, irrespective of its chemical constitution, may exist in the colloidal state. It is even possible to have colloidal crystals, and Scherrer demonstrated by x-ray analysis that colloidal gold particles at the lower ranges of the colloidal dimensions are crystalline.

As particles become smaller and smaller, the Brownian motion, just noticeable at the lower microscopic limits, increases very greatly in speed and

amplitude; for kinetic motion depends (among other factors) on the mass; and, assuming spherical shape for convenience of calculation, the *mass* varies inversely as the *cube* of the diameter of the particle if no change in specific gravity accompanies dispersion. On the other hand, the *surface* of the particles varies inversely with the *square* of their diameters. The subjoined diagram indicates that in passing downward through the colloidal zone, we go from a condition where kinetic motion is relatively negligible as compared with the specific surface (that is, free surface per unit of weight), to a condition where the kinetic motion is of great importance, despite the large increase in specific surface. There thus naturally arises a *zone of maximum colloidalty*, wherein the consequences of specific surface become most manifest before the consequences of kinetic motion become dominant. For example, maximum hardness in steel corresponds, approximately, to a colloidal dispersion of the iron carbide (cementite) in the iron. Both 5 per cent. starch suspensions and dextrose solutions show but slight increase in viscosity over water, whereas 5 per cent. starch colloiddally dispersed, *e.g.*, by boiling, is very viscous. The importance of the zone of maximum colloidalty in biology and medicine has been stated thus:<sup>1</sup>

A most striking example of optimum dispersion is found in living matter. Figuratively speaking, if all the chemical substances comprising our organism were in true or crystalloid dispersion, reactions would proceed so rapidly that we would, so to say, live ten years in ten minutes. On the other hand, if coarse dispersion prevailed, it would take ten years to live ten minutes. Every organism is dependent upon the coordination of its chemical reactions *in point of time*, and this leisurely procedure depends largely upon *degree of dispersion*, which keeps chemical reaction velocities within certain speed limits through its regulation of free surface and kinetic activity. Life lies between lysis and coagulation. The colloidal zone is, as it were, a vital metronome, tolling off the tempo of life.

The extensive literature of colloid chemistry shows how large a number of factors influence the behavior of colloid particles, apart from the important one of size. For example, though for convenience we assume the particles to be spherical, they might have shapes widely differing from spheres. The specific gravity, chemical specificity and electric charge of particles and the nature of the medium in which they are dispersed are all of importance in determining their behavior. This literature also shows how wide-spread and important is the colloidal state on our relatively minute earth. It is only natural that we should expect

to find instances of colloidal dispersion throughout the immensity of space, that is, in the field of astronomy.

An outstanding instance of the zone of maximum colloidalty appears in the case of comets, whose nuclei, comas, and tails consist in part of colloidal matter. In 1870 J. Clerk Maxwell pointed out that the intensity of action of the sun's rays on a particle is in proportion to the particle surface which varies as the *square* of the particle diameter, whereas the gravitational pull of the sun on the particle varies as its mass which is proportional to the *cube* of its diameter. Theoretically, with particles having the density of water, the repulsion due to "light pressure" balances the solar attraction due to gravitation when the particles have a diameter of 0.0015 mm (1.5  $\mu$ ). As particle size diminishes, the repulsive force gains domination over gravity, reaching a maximum and again diminishing, until with particles having a diameter of only 0.00007 mm (70  $m\mu$ ) the two forces once more balance each other. These limiting dimensions must be still further reduced in the case of particles denser than water, so that it would appear that the sun selectively repels colloidal particles to form cometary tails, which, as spectroscopic observations indicate, shine mainly by reflected sunlight. The comet's tail is, therefore, an extremely tenuous celestial camouflage, a vast Faraday-Tyndall effect, analogous to what a searchlight beam shows in a foggy or dusty atmosphere. The earth recently passed through a comet's tail without appreciable effect, although yellow journals prophesied dire consequences and members of a certain sect gathered in church to await the impending "end of the world" and last judgment.

According to calculations by Schwarzschild, the effects of light-pressure are insignificant on particles having the dimensions of gas molecules, when compared with the effect of gravity. More recently, P. Debye<sup>2</sup> confirmed Schwarzschild's conclusions by making an extensive re-analysis of this problem, basing his calculations on the classical radiation theory and upon the electron theory of Lorenz. This indicates that colloidal particles are selectively repelled by the sun, both larger masses and gases tending to be attracted. Most comet's tails show the spectra of nitrogen and of carbon monoxide, while cyanogen and carbon do not appear to extend much beyond the cometary head. We know little of the formation and stability of chemical compounds under the conditions of temperature and of electronic and mechanical turmoil which prevail when a comet approaches the sun and develops a tail; but we do know that colloidal "smokes" tend to "hold" gases and were, in fact, used for this purpose to "carry" gases during the world war.

Though very exceptional, heliocentric tails, that is,

<sup>1</sup> Jerome Alexander, "Colloid Chemistry, Theoretical and Applied," Vol. I, p. 25. Chemical Catalog Company, 1926.

<sup>2</sup> *Ann. der Physik.*, 30: 57-136, 1909.

tails pointing toward the sun, are known and, according to Professor N. T. Bobrovnikoff (Ohio Wesleyan University), were seen in Comets 1844 III, 1862 III and 1882 II. Such tails might consist of particles larger or smaller than colloidal dimensions, and in the former case would support the view of Bredichin that they are responsible for meteoric showers.

Matter in colloidal dispersion also finds place in the planetesimal hypothesis advanced by T. C. Chamberlin and F. R. Moulton to account for the formation of the solar system. According to this hypothesis, which finds wide acceptance, about ten or twenty billion years ago a star approached our sun closely enough to tear loose and send whirling through space a small percentage of the sun's mass. No direct "side-swiping" was needed, for the nearest approach of the visiting star may have been of the order of the earth's distance from the sun; but the enormous gravitational fields probably caused explosive or pulsating ejection of matter from both sun and star. Part of this fell back into the sun, part was carried off by the visitor as it departed after a "visit" of several months, and part, estimated as about one seventh of one per cent. of the total solar mass remained swirling about the sun in the direction of the visitor's exit, and irregularly distributed because of the explosive and pulsating nature of its ejection. This accounts for the more or less orderly spacing of the planets, for their uneven sizes, as well as for the fact that they all rotate in one direction and approximately in the same plane. The retrograde moon of the large planet Jupiter seems to represent a "capture," possibly a small comet, a large meteorite or other invader.

The ejected matter was probably initially gaseous for the most part, but as it cooled it condensed into larger and larger particles, which then accumulated into planets and satellites under the action of localized gravitational forces. In passing from gaseous to microscopic dispersion the colloidal zone must be traversed, and frequently colloidal particles persist indefinitely. So-called "cosmic dust" appears to be of such nature, and the enormous "dark nebulae" appear to consist of vast clouds containing colloiddally dispersed matter, which, by obscuring the light of exterior bodies and systems, make the so-called "coal holes" which astronomers find in the heavens. Enormous amounts of finely dispersed matter are still being gathered in by the gravitational pull of the sun and the planets. The study of radioactive phenomena has so enlarged our notions of time that according to Professor F. K. Morris the Cenozoic period is pushed back to at least 50 million years ago, while our oldest visible rocks go back about to 1,500 million years.\*

\* See also H. N. Russell, *SCIENCE*, 92: 19 (July 12, 1940).

The solar corona, in its outer ranges, may have colloiddally aggregated matter of evanescent life, and according to Professor H. N. Russell the galactic nebulae also contain colloidal material, although the brighter spiral nebulae, which are at much vaster distances, consist of aggregations of stars.

The zodiacal light may represent an aftermath of the birth of the solar system, for it consists of a cloud of tenuous matter shining by reflected solar light. Saturn's rings appear to be more concentrated, for they cast shadows and their solid content is estimated to be 2 to 3 per cent. of their volume. But the constant attrition of solid chunks in Saturn's rings, in cometary heads, as well as the occasional collision of bodies in space and the aggregation of radiated matter, all furnish renewed supplies of finely dispersed material. Colloidal particles must appear and must be given consideration. Colloidal dispersions of matter in the aether of space have been termed *aethersols*, in contra-distinction to colloidal dispersions in our atmosphere which are known as *aerosols*. Apart from their importance in meteorology, aerosols are of considerable military and commercial significance.<sup>3</sup>

From the standpoint of meteorology aerosols fall into two groups: *organic* material, such as bacteria, spores, pollen and vegetable fragments; *inorganic* material, such as water and ice, rock and soil particles, volcanic ash, meteoric and cosmic dust, salts from drying of sea-spray, and hydrated nuclei of various chemical compounds like nitric oxide, ammonia, hydrogen peroxide, sulphurous and sulphuric acid, which may be formed in the atmosphere by solar radiation, or by electric discharges, or else enter it as a consequence of combustion of fuel. The ever recurring evaporation of water and its condensation through the colloidal zone into liquid or solid form, takes place on a gigantic and continuous scale.

According to Dr. W. J. Humphreys our atmosphere is coincident with the konisphere (dust sphere), and contains the following layers:<sup>4</sup>

(1) *Turbulenc layer*, approximately one kilometer in height, which can often be seen from mountain tops as a haze with a more or less sharply defined upper surface.

(2) *Convection layer*, in which thermal convection is marked. "Its upper surface, often three kilometers, roughly, above the earth, frequently is a sharply horizoned ocean, as viewed from an aeroplane, in which cumulus clouds stand like islands in the sea."

(3) *Troposphere*, extending to the level of the highest clouds; in our latitude approximately 10 to 12 kilometers, though it tends to be higher in equatorial regions and lower toward the poles. Because of its great height its

<sup>3</sup> Jerome Alexander, *Popular Astronomy*, 33: No. 7, 1925.

<sup>4</sup> W. J. Humphreys, Alexander's "Colloid Chemistry, Theoretical and Applied," Vol. I, p. 424.

upper surface is seldom seen but is indicated by certain polarization phenomena of skylight. Into this tropic layer, vertical convection due to sudden temperature changes, sometimes brings terrestrial dust.

(4) *Stratosphere*, comprising everything above the tropic layer. Colloidal particles coming from the "daily millions of meteors," from hygroscopic nuclei, and from dust hurled to enormous heights by violent volcanic eruptions, supply nuclei for the highest cirrus clouds.

According to Dr. Humphreys, the weather records of the past three centuries show that cloudy and cool summers followed on explosive volcanic outbursts. In 1815 a great eruption of Tomboro (Sumbawa Island in the East Indies) killed 12,000 persons, and the next year (1816) is known as the "year without a summer," for there was snow in June and in August. The explosive eruption of Krakatoa (1889) traveled thrice around the earth according to barometric records, and for several years the high-flung dust caused "golden sunsets." The lava of the Tomboro eruption has been estimated at six cubic miles, whereas Professor Wilbur A. Nelson calculated that during the Cretaceous period a now extinct volcano in Kentucky spat up 50 cubic miles of lava, whose fall may be traced 800 miles north and south, and 450 miles east and west of the crater. We can readily understand how in ages of great volcanic activity the climates and rainfall throughout the earth must have been seriously affected, even to the extent of glaciation. In 1932 ash from Chilean volcanoes reached as far as Rio de Janeiro in four days, a distance of 1,800 miles, and marked weather disturbances were reported in Argentine.<sup>5</sup>

The quantities of dust carried by winds is much greater than most people would imagine. They are sufficient to delay the twilight, for example, at Assuan in upper Egypt, for about 45 minutes. In March, 1901, a cyclonic storm central over Tunis raised dusts from the Algerian deserts to such high levels that one third of the 1,800,000 tons that fell in Europe dropped north of the Alps. About 150,000,000 tons are estimated to have fallen on the African coast, and an unknown amount into the Mediterranean Sea. Dust storms in Peiping are notorious, the dust clogging fountain pens, obscuring printed pages and causing what is called "Peiping throat." In the spring of 1934 some 300,000,000 tons of earth were lifted from the drought-parched western states by a strong north-west wind and scattered over half of our country. The legendary "Sea of Darkness" lying between the Canary and Cape Verde Islands is accounted for by the dust falls from Sahara, common there between January and April.

The incidence of goiter and cretinism, mainly due to

iodine deficiency, is highest in regions remote from the sea, where salt dust formed by the drying of ocean spray is less apt to reach soil and water, and furnish the small but essential traces needed for the formation of thyroxin in the thyroid gland. It would take a person about 1,000 years to drink enough of the water of Lake Superior to give him the necessary supply of iodine, so that we can understand the importance of the unseen colloidal salt particles in our atmosphere.<sup>6</sup>

Weather conditions are, to a large extent, determined by the nature of the dispersion of water in the atmosphere; and to a considerable degree, the presence of condensation nuclei control water dispersion, and local conditions lead to the formation of haze, mist, fog, rain, snow or hail. The high incidence of dense fogs in London is largely attributable to the presence of nuclei resulting from the burning of coal, etc. Professor Carl Barus<sup>7</sup> kept a continuous record of atmospheric nucleation for several years at Providence, R. I. He found that the number of nuclei varied from about 2,000 to 100,000 per cubic centimeter; and though it varied greatly during each day as well as from day to day, it was much greater, on the average, about the time of the winter solstice when most fuel is burned, and least about the summer solstice. The most effective nucleators are substances which produce highly dispersed, hygroscopic or soluble particles. If fog be formed on such nuclei and then evaporated, the hydrated nuclei persist and will determine fog formation without material supersaturation. The luminous "paths" whereby one follows the emission of radium "rays" consist of strings of tiny water droplets deposited on strings of ionized particles, so numerous as to appear to be a continuous line in the Wilson fog-chamber. Nuclei are produced in quantity by brush discharges and even by impinging water jets.

When air containing moisture is cooled, supersaturation occurs and the moisture tends to condense. For example, in Hawaii the warm moist trade winds, in rising to pass over the high mountains, are cooled by expansion as the pressure is thus reduced, and thick clouds and heavy rains occur in the mountain tops and higher valleys; but the clouds evaporate as they move on, over the crests. Showers from a cloudless sky, locally known as "liquid sunshine," occur when the wind is strong enough to blow the mountain rain into a cloudless area. This is common in Honolulu. Cloud streamers are common on very high mountain peaks, *e.g.*, the Matterhorn; and in 1936 a "plume" seven miles long was observed streaming from Mt. Everest. Similarly, in the arctic regions, despite the small moisture content of the air, the intense cold

<sup>5</sup> *Ibid.*

<sup>6</sup> Jerome Alexander, "Colloid Chemistry," 4th ed., D. Van Nostrand Company, 1937.

<sup>7</sup> Carl Barus, Alexander's "Colloid Chemistry, Theoretical and Applied," Vol. I, p. 420.

produces very curious phenomena. Thus Rear Admiral Richard E. Byrd reports that the small amount of moisture held by air at 50 degrees below zero (F.) forms a real fog when thrown out by mixture with colder air; and "when a man stood inside the entrance to one of the house tunnels, the vapor formed by his breathing was so heavy the house appeared to be on fire."<sup>8</sup>

The raindrops which determine the formation of rainbows are much larger than colloidal dimensions, and so, in most cases, are the tiny ice crystals which cause halos about the sun, rings about the moon and the numerous other allied phenomena known to meteorologists. However, in many cases colloidal dispersions form, even though they may have a transient existence. "Solar rainbows," often seen in the tropics and just recently seen here, are due to very high float-

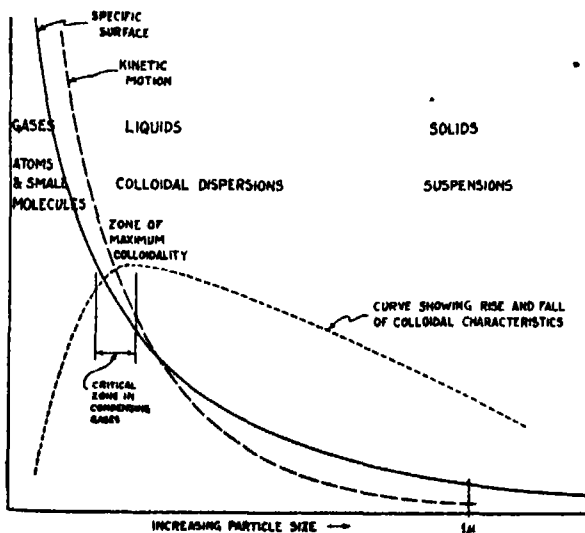


FIG. 1.

ing ice particles. Finely dispersed particles are responsible for the "blue" color seen in certain lakes and portions of the ocean, in highly dilute emulsions or suspensions (*e.g.*, of milk), in glacial streams and possibly in glaciers. In 1913 Professor W. H. Martin<sup>9</sup> carefully freed liquids and gases from dust and found that they would scatter light. This was direct experimental proof of the theory of Lord Rayleigh that the blue color of the sky is due to scattering of light by air molecules, which are, of course, much below colloidal dimensions. In nature, however, liquids and gases are always contaminated with dispersed impurities, and these often exert a marked effect. In the absence of atmospheric dust, night descends abruptly, in contrast to the delayed twilight before referred to.

<sup>8</sup> Jerome Alexander, "Colloid Chemistry," 4th ed.

<sup>9</sup> W. H. Martin, Alexander's "Colloid Chemistry, Theoretical and Applied," Vol. I, p. 340.

Colloidal haze causes a glare which prevents perception of distant detail, but which may be filtered out so that better vision is had through the long-wave fog-piercing portion of the spectrum. The use of neon lights for beacons, and infrared photography involve recognition of the fact that the amount of light scattered from its course is inversely proportional to the fourth power of its wave-length. Sunset and sunrise colors are mainly yellows and reds, whereas distant mountains often appear blue. In his story "Rip Van Winkle" Washington Irving refers to the fact that the appearance of the Catskill Mountain is a weather indicator to be relied on.

Clouds generally carry electric charges due to the capture of ions, electrons, surface electrification, etc. Since the charge is carried on the surface of the droplets, their aggregation, evidenced by development of a dark or livid shade, leads to very high voltages which can break down intervening resistance and form a lightning flash. In 1875 Gaston Planté produced globular brush discharges which sometimes formed wandering globular sparks. He pointed out that "ball lightning" involves the same principles, and stated: "Although an aqueous surface is not indispensable for forming luminous electric globules, since we have obtained them over a metallic surface, the presence of water, or of vapor from water, at least facilitates their formation or tends to give them more volume because of the gases furnished by the decomposition of water at high temperatures." J. C. Jensen recently reported that ball lightning occurs most frequently in connection with dust, *e.g.*, from a fire-place or in a squall or tornado. The explosive effects so often reported, seem to involve an oxyhydrogen explosion, which would be all the more violent if atomic hydrogen (Langmuir) were first produced.<sup>10</sup>

Thomas Graham, F.R.S., the father of modern colloid chemistry, in commenting on the colloidal characters of ice at or near its melting point, points out that although ice formed at temperatures a few degrees under the freezing point has the well-marked crystalline structure seen in snow or hoar frost, ice formed in contact with water at 0 degrees C. is a plain homogeneous mass with a vitreous fracture, exhibiting no facets or angles. The beautiful crystals recently demonstrated in ice blocks by Sir William H. Bragg may, perhaps, be due to a molecular rearrangement, which Graham gives as an explanation of the observation of Mr. Persons that ice cooled below 0 degrees C gives off heat. After referring to Funke's "blood-crystals" which form in a highly colloidal material, Graham concludes: "Can any facts more strikingly illustrate the maxim that in nature there are no abrupt transitions, and that distinctions of class are never absolute?"

<sup>10</sup> Jerome Alexander, "Colloid Chemistry," 4th ed.

## OBITUARY

## JAMES W. GLOVER

THE passing of James W. Glover, long identified in many ways with the University of Michigan, marks an era in American mathematics whose continuance gives promise to extend indefinitely into the future. Probably in a greater degree than to any other single individual, the present place of actuarial mathematics, with the mathematics of finance and of statistics, owes its prominence in American colleges to this Michigan man.

Under the stimulus of Dr. Glover's active interest, Michigan began in 1906 to give courses in the mathematics of finance and insurance. The peculiar merit of this development lies in the fact that the necessary mathematical courses supporting sound instruction in actuarial science were immediately developed at Michigan. Within a few years, so rapidly because of the multiplicity of insurance investigations in the public eye and mind at that time, students in large numbers desirous of serious preparation for the expanding insurance fields came to Michigan for instruction.

Even in the early period elementary statistical courses received some attention. However, a few years later with the arrival of Harry C. Carver (1916), further statistical courses and also casualty insurance courses were developed. This was made possible as the broad and scholarly foundation which had been prepared for the actuarial courses served also for the newer developments. In this program Professor Glover participated in every way.

As early as 1906 Dr. Glover was appointed as consulting actuary to the Wisconsin Legislative Investigation Committee, continuing in Wisconsin the following year with the Joint Committee on Banks and Insurance. In 1896 the Canadian Royal Commission on Insurance summoned Professor Glover as expert. The National Government employed the Michigan teacher as expert special agent in the U. S. Census Bureau (1910), where he served many years, editing United States Life Tables of 1890, 1901, 1910 and 1901-10, published by the Government Printing Office. Such books are equivalent in circulation, often, to "best sellers." Connections Professor Glover had also with the Departments of Agriculture and Labor and the Treasury (Advisory Board, War Risk Insurance).

The State of Michigan and the university both called frequently upon their expert for his technical assistance. Both the Michigan Teachers' Retirement Fund and the favorable provisions made by the regents of the university for faculty retirement owe much to the activity of Michigan's actuarial department.

This type of service in the public interest so well

represented by the life of James W. Glover indicates, in a way, the most vital success of a professor in a state university. Instruction is, of course, the primary public service, but a state employee is obligated to direct his activities to protecting the public interest in other ways when possible.

For many years examinations for admission to the actuarial societies were held in Ann Arbor. This was but one piece of evidence of the large and important group of Michigan-trained members. Upon the retirement of Professor Glover, at seventy as required at Michigan, these national societies tendered a testimonial dinner in Chicago given by Glover's former students. Some two hundred, including many executives of major companies, attended.

A fellowship in insurance was established at this meeting in the name of the Michigan teacher.

Dr. Glover's long connection as trustee, elected by the members, with the Teachers' Insurance and Annuity Association culminated in his appointment as president of the company, in which office he served for two years, 1930-1932.

In the department of mathematics at Michigan, Dr. Glover rose with some rapidity after eight years of service as instructor in mathematics, to the rank of professor of mathematics (1911-1938), later serving also as chairman of the department.

As a teacher and as an administrator at Michigan, Professor Glover was in the highest degree successful. As an administrator Dr. Glover was quick to follow words of praise by action with respect to the budget. In the matter of books, journals, technical equipment and even research assistants, Professor Glover was ever quick to seize any opportunity to be of service to the men at Michigan. The men brought into the department during this period were selected with great care for their academic promise, which has in extraordinary measure been justified by their subsequent publications.

In 1900 Dr. Glover married Miss Alice Durfee Webber, of Ann Arbor, who, with the son, James W. Glover, born in 1901, survives him.

Undoubtedly the most important literary activity of Professor Glover was that in connection with the U. S. Census Life Tables (1890, 1901, 1910 and 1901-1910), published in Washington. In addition to many articles, Professor Glover (with Harry C. Carver) in 1921 issued tables of compound interest functions, still published by George Wahr in Ann Arbor. A number of other important sets of tables and statistics followed upon this. In 1935 (with Walter O. Menge) was published the "Mathematics of Life Insurance" (Macmillan Company).

Such is the record of an active life, enriched by

many enduring friendships, covering many important developments in America's mathematical history, in

the formative days of fields now of the utmost importance.  
LOUIS C. KARPINSKI

## SCIENTIFIC EVENTS

### THE FEDERAL DEPARTMENT OF HEALTH OF BRAZIL

THE correspondent of the *Journal* of the American Medical Association at Rio de Janeiro writes: "President Getulio Vargas has signed a decree reorganizing the national department of health. This reorganization and enlargement emphasize the interest that the present government has taken in problems relating to public welfare and gives to the federal bureau of health a status near that of a ministry. All activities related to problems of health under the federal government, with the exception of those concerning the child, have been consolidated under a general director in the Ministry of Education and Health. Even the well-known Oswaldo Cruz Institute, which previously enjoyed the position of an independent institution of research and study in the general field of experimental medicine, has been included in the new organization. The decree states that the national department of health will promote surveys, research relating to health, sanitation and hygiene, the epidemiology of diseases and the methods of their control and treatment and will directly administer the activities connected with these problems and others related to health.

"Dr. J. de Barros Barreto, an able sanitarian and executive, has been appointed director general of the department.

"The national department of health is composed of several divisions: the division of public health organization, which cooperates with the states and counties to create and conduct local health units; the division of hospitals, which is intended to foster throughout the country the creation and improvement of hospitals, a matter in which Brazil is well below her necessities, and the division of tuberculosis and the division of leprosy. The federal government has already appropriated and paid to more than twelve of the twenty states of Brazil the means to build and equip sanatoriums, preventoriums and leprosariums. The division of yellow fever includes the well-known organization developed with the cooperation of the International Health Board of the Rockefeller Foundation. The work against *Aedes* in the cities, which have been practically free of the disease for several years, and the work against 'jungle yellow fever,' still prevailing in many rural communities, including the extensive use of viscerotomy and vaccination, is already being performed by Brazilian personnel. The Rockefeller Foundation

conducts the Yellow Fever Laboratory, built within the premises of the Oswaldo Cruz Institute, where research is carried on and the vaccine is prepared. The division of malaria is expected to expand the antimalarial work. The Federal Bureau of Health was already doing the work against malaria, especially in the Federal District (suburbs of Rio de Janeiro City), in the neighboring state of Rio de Janeiro and in the Gambia infected northeast area (states of Ceara and Rio Grande do Norte), the latter area where the Rockefeller Foundation has cooperated extensively. Other divisions are devoted to mental diseases, health education, plague, vital statistics, maritime quarantine and the licensing of drugs.

"Among the new functions of the Oswaldo Cruz Institute is the education of public health medical specialists, as the course in hygiene and public health has been transferred from the medical school of the University of Rio de Janeiro to the institute."

### GRANTS OF THE GEOLOGICAL SOCIETY OF AMERICA

AMONG the grants authorized in May by the council of the Geological Society of America are the following:

*General, Geomorphology and Stratigraphy*—\$3,624.50.

Fritiof M. Fryxell, Augustana College, will spend ten weeks, with Leland Horberg, University of Illinois, and two assistants, studying the structure, erosional history and glacial geology of the Teton Range, Wyoming. \$440.

Lewis B. Kellum, University of Michigan, will return to northern Mexico to complete the mapping of Sierra de Tlahualilo and Sierra del Rosario in further study of the Coahuila Peninsula and the position of the continental margin in Mesozoic time. The University of Michigan will contribute an equal sum. \$2,000.

L. L. Ray, Michigan State College, and J. Fred Smith, Jr., Texas Agricultural and Mechanical College, will spend ten weeks mapping the geology of the Cimarron Range, New Mexico, in continuation of their study of the structure, physiography and geologic history of the Sangre de Cristo Mountains. \$525.

H. T. U. Smith, University of Kansas, will study periglacial phenomena, particularly those related to intensified frost action, in the Blue Mounds, Baraboo and Trempealeau regions of the Driftless Area of Wisconsin. \$87.

Arthur N. Strahler, Columbia University, will spend six weeks in the east Kaibab monocline and adjacent parts of the Grand Canyon region completing a study of the geomorphic history of the region in which in 1939 and 1940 he had assisted Donald L. Babenroth, deceased. \$287.50.

J. Stewart Williams, Utah State Agricultural College,

will spend three months correlating the Carboniferous rocks of the Wasatch with those of the Uinta Mountains and those of southeastern Idaho. \$285.

*Geochemistry*—\$8,450.

Easper S. Larsen, Harvard University, will continue with the spectrographic determination of the rarer elements in groups of rocks from petrographic provinces. This work was begun under a previous grant from the society. \$2,250.

W. J. Mead, the Massachusetts Institute of Technology, in cooperation with Robley D. Evans, directing the work of Clark Goodman and Patrick Hurley, will conclude the investigation of the determination of the age of rocks by the helium method. \$6,000.

O. B. Muench, New Mexico Highlands University, will continue his investigation of the age of rocks and minerals by lead-uranium method by careful analysis of the minerals for lead, uranium and thorium. \$200.

*Geophysics*—\$3,400.

Rev. Daniel Linchan, S.J., Weston College, Massachusetts, will conduct a series of seismic surveys in the Triassic formations of the Connecticut Valley to determine their depths and the characteristics of the major faults. \$400.

George P. Woollard, Princeton, N. J., is to make an areal gravitational and magnetic survey in the Atlantic Coastal Plain and Piedmont provinces from New Jersey at least through Virginia. Marked anomalies are known in the area, elevation data are largely available, and the geology is well enough known to play its vital role in interpretation. \$3,000.

*Glacial*—\$2,700.

J. Harlen Bretz and W. D. Jones, University of Chicago, will go to Alberta to map glacial moraines, correlate soil profiles with moraines and associated till sheets and study the relation of continental ice sheet moraines to the Cordilleran valley moraines in the latitude of Edmonton. \$450.

Max Demorest, Yale University, will complete his program of laboratory research on the physics and deformation of ice. \$100.

Holmut de Terra, New School for Social Research, is to make a field study of late Quaternary glaciation in the Uinta Mountains in an effort to date certain Stone Age cultures discovered near Fort Bridger, Wyoming. \$375.

Chauncy D. Holmes, University of Missouri, will devote eight weeks to mapping the boundary between the Nebraskan and Kansan drift sheets in Missouri. He will also endeavor to obtain data on direction of ice movement through study of preferred long-axis directions of embedded stones. \$300.

Paul Mac Clintock, Princeton University, and Earl T. Apfel, Syracuse University, will work for ten weeks in the Salamanca re-entrant where the moraines of the Mississippi Valley region meet those of Pennsylvania and New Jersey. They are to correlate the Wisconsin drifts on the two sides of the re-entrant. \$600.

Hakon Wadell, University of Chicago, will make a comprehensive survey of the esker problem. \$600.

George W. White, University of New Hampshire, will study the drift border in eastern Ohio to determine

whether there is more than one drift, the exact location of the drift limits and the mode of retreat of the last ice sheet. \$275.

## THE ANNUAL REPORT OF THE DIRECTOR OF FIELD MUSEUM OF NATURAL HISTORY

THE annual report of Dr. Clifford C. Gregg, director of Field Museum of Natural History, a book of more than 150 pages illustrated with ten collotype plates, appeared on August 6. The report is several months later than usual due to unusual conditions in the division of printing.

It is recorded that Marshall Field, a member of the board of trustees, made gifts to the museum amounting to \$284,680. From Stanley Field, president of the museum, contributions totaling \$22,700 were received. Mrs. James Nelson Raymond, founder of the James Nelson and Anna Louise Raymond Foundation for Public School and Children's Lectures, which provides special museum services, provided \$6,000 to be used toward the operating expenses of the foundation. This foundation was established and endowed by Mrs. Raymond in 1925. Among other contributors are: Charles H. Schweppe, Chicago, \$2,500; Mrs. Clarence C. Prentice, Chicago, \$1,000; the Rockefeller Foundation, \$1,000. Legacies received during the year include \$10,000 from the late Frederick T. Haskell, and \$8,000 from the late William B. Storey.

The General Electric X-ray Corporation, Chicago, presented to the museum an x-ray apparatus, fluoroscopic screens, mechanical devices for automatic control and timing and all other accessories for an exhibit in which an Egyptian mummy is shown intermittently with the projection of the x-ray image of its skeleton. Additions were made to the collection of Chinese ivory objects through a bequest of the late Louis L. Valentine. Large and unusual specimens of game fishes were presented by Michael Lerner, of New York.

In the introduction to his report, Major Gregg states:

Again I am privileged to report substantial success in many lines of activity. Perhaps the principal emphasis has been placed upon the rehabilitation of the building itself. For several years financial conditions and the pressure of new construction and expansion have interfered to some extent with both ordinary and extraordinary maintenance of the splendid structure housing our collections. During the past year . . . necessary repairs have been made or are well under way.

The principal exhibition feature of note was the opening of the new Hall of Babylonian Archaeology bringing to a culmination the work of about seventeen years, beginning with the Field Museum-Oxford University Expedition to Kish (1923-38).

Museum attendance for the year was 1,450,685, exceeding the number of visitors in the previous year by more than 40,000. It is pointed out that extramural educational activities, conducted by the Raymond Foundation and the N. W. Harris Public School Extension, brought the total number directly reached by museum activities up to nearly 2,200,000. Millions of others received scientific information from the museum through indirect channels such as radio, publications and press reports.

Detailed reports are given of the activities of the four scientific departments—anthropology, botany, geology and zoology; and of all other divisions of the museum, educational, administrative, public service, maintenance, library, etc. The report contains also a complete membership list.

### U. S. CIVIL SERVICE EXAMINATIONS

THE U. S. Civil Service Commission reports that the Government continues its search for specialists in all branches of industry and business. The Federal Civil Service examination for industrial specialist, announced on July 7, has been amended to remain open for receipt of applications until further notice. The National Defense Program needs men with experience in one or more of the following fields: Iron and steel, non-ferrous metals, machine tools, ordnance, aircraft, marine and automotive equipment, railroad repair shops, radio and other electrical equipment, supplies and apparatus, textiles, forest products, paper, printing and publishing, chemicals and allied products, plastics, petroleum and coal products, rubber products, stone, clay and glass products, leather and its manufactures and food and kindred products. Salaries range from \$2,600 to \$5,600 in the various grades. No written examination is given.

Those trained in engineering are again called upon for government service. An examination will be given for engineering aids in two fields: photogrammetry

and topography. Salaries range from \$1,620 to \$2,600 a year. Persons are particularly needed in the three lower grades (paying \$1,620 to \$2,000) in the field of photogrammetry. A written test will not be given but competitors will be rated on their education and experience. Although the completion of 14 units of high-school study is a basic requirement, applicants may substitute an additional six months' engineering experience. In addition they must have had responsible civil engineering experience, including some work in the optional branch selected.

To secure economists in all branches of economics for government service the commission announces an examination for positions paying from \$2,600 to \$5,600 a year. Applications will be accepted until further notice and will be rated as soon as practicable after receipt. Those who filed applications for the general economist examination announced in September, 1940, and who received eligible ratings need not file another application. However, if they wish to apply for a higher position, they should file a new application. Superintendents of building maintenance are needed by the Federal Works Agency. Positions are to be filled in public housing projects and public buildings in various sections of the country. The salaries range from \$2,600 to \$3,800 a year. Applications must be filed not later than August 26, 1941. A written test will not be given, but applicants must show experience of the proper scope and responsibility. To qualify as junior superintendent (\$2,600 a year) four years of experience is required; for the superintendent positions (\$3,200 a year) six years; and for the senior superintendent (\$3,800 a year) nine years. Applicants for these positions must not have passed their fifty-fifth birthday.

Further information and application forms for these examinations can be obtained at any first- or second-class post office or from the Civil Service Commission in Washington.

## SCIENTIFIC NOTES AND NEWS

DR. GEORGE D. BIRKHOFF, Perkins professor of mathematics at Harvard University, has been elected an honorary member of the London Mathematical Society.

THE degree of doctor of science has been conferred by McMaster University, Hamilton, Ontario, on Dr. Donald Church Balfour, director of the Mayo Foundation and past-president of the American College of Surgeons.

THE honorary degree of doctor of science was awarded at the commencement exercises of the University of Maryland to Dr. Wortley F. Rudd, dean of

the School of Pharmacy of the Medical College of Virginia.

SIR ROBERT ROBINSON, Waynflete professor of chemistry at the University of Oxford, was awarded on August 6 the first Paracelsus Gold Medal of the Swiss Society of Chemistry.

PROFESSOR EMIL ABDERHALDEN, professor of physiology in the University of Halle, has been made an honorary member of the Society of Physics and Natural History of Geneva.

*Nature* states that Griffith Brewer has been elected president of the Royal Aeronautical Society for the

year October, 1941–September, 1942; Professor L. Bairstow, W. C. Devereux and the Right Honorable J. T. C. Moore-Brabazon have been elected vice-presidents.

DR. ANDREW C. IVY, professor of physiology and pharmacology at the Medical School of Northwestern University, has been elected president of the Chicago Society for Internal Medicine.

DR. A. M. HARDING, professor of mathematics and astronomy at the University of Arkansas, became president of the university on July 1.

DR. BENNET M. ALLEN, professor of zoology at the University of California at Los Angeles, has been appointed acting dean of the Graduate Division. He will take the place of Dr. Vern O. Knudsen, who has been granted a leave of absence to assist in a national defense project. Dr. Knudsen's leave will continue until the end of December, and will probably be continued.

LAURENCE J. ACKERMAN, associate professor of insurance of the University of Newark, has been appointed dean of the School of Business at the University of Connecticut.

FREDERICK K. TEICHMANN, associate professor of aeronautical engineering, has been appointed acting director of the department of aeronautical engineering at New York University. He succeeds Dr. Alexander Klemin, formerly head of the Guggenheim School of Aeronautics, who last spring retired as director to become research professor of aeronautics.

At the University of Minnesota Dr. Clarence M. Jackson, professor and head of the department of anatomy, who retired at the close of the academic year, has been appointed professor emeritus. A committee consisting of the following professors has been formed to administer the department for the coming year: Dr. Edward A. Boyden, chairman; Dr. Andrew T. Rasmussen and Dr. Hal Downey. Dr. C. D. Creevy has been promoted to a professorship of surgery. He has also been made chief of the division of urology and assistant dean of the Medical School; Dr. James A. Johnson has been appointed clinical professor of surgery.

DR. SAMUEL R. M. REYNOLDS, associate professor of physiology at the Long Island College of Medicine, has been appointed research associate of the Carnegie Institution of Washington, in the department of embryology, Baltimore. He will assume his duties there on September 1.

MORTIMER MENAKER, who was granted the Ph.D. degree in agricultural biochemistry at the Pennsylvania State College in August, has joined the research staff of the Fisher Scientific Company at Pittsburgh.

DR. ALBERT EDWIN SIDWELL, JR., has been named director of the Chemical Laboratory of the American Medical Association in Chicago, a unit of the Division of Drugs, Foods and Physical Therapy. He has been a chemist in the chemical laboratory since 1938.

RAYMOND G. BENDER has resigned his position as research chemist with the Borden Company, Research Division, Bainbridge, N. Y., to become chemist and plant manager of the Harris Laboratories, Tuckahoe, N. Y.

DR. GEORGE B. KISTIAKOWSKY, professor of physical chemistry at Harvard University, and Dr. Robert C. Elderfield, professor of organic chemistry at Columbia University, members of the National Defense Research Commission, who have been in England, arrived in New York on the American Clipper from Lisbon on August 4.

ACCORDING to the *British Medical Journal*, Dr. G. M. Findlay, of the Wellcome Research Institute of London, will direct the manufacture of yellow fever vaccine for the South African Institute for Medical Research in Johannesburg.

THE following pharmacologists are working at the California Medical School this summer: Dr. F. Luedena, of the University of Rosario, Argentina; Dr. Hamilton H. Anderson, of Peiping Union Medical College, China; Dr. S. A. Peoples, professor of pharmacology at the University of Alabama; Michael Shimkin, of the National Institute of Health, Washington, D. C., and Dr. P. K. Knofel, professor of pharmacology at the University of Louisville.

WITH reference to a note in *SCIENCE* for June 20, we learn from Dr. Frans Verdoorn, editor of *Chronica Botanica*, that Dr. L. G. M. Baas-Becking has been released by the German authorities and that he has assumed again the directorship of the Botanical Institute of the University of Leyden.

DR. WILLIAM DE B. MACNIDER, Kenan research professor of pharmacology at the Medical School of the University of North Carolina, delivered a series of three lectures on July 29, 30 and 31 on "Acquired Resistance of Tissue Cells," under the auspices of the department of materia medica and therapeutics of the Medical School of the University of Michigan. The subjects of his lectures were "The Repair of Tissue and Tissue Resistance," "The Ageing Process and Tissue Resistance" and "The Adjustability of the Life Process to Injurious Agents."

THE Pacific Coast Convention of the American Institute of Electrical Engineers will meet at the Yellowstone National Park on August 27, 28 and 29. Headquarters will be at the National Hotel.

THE eighth annual Metal Mining Convention and

Exposition of the American Mining Congress, Western Division, will be held at San Francisco from September 29 to October 2. The subject of the meeting will be "Metals for Defense." In addition to the program devoted to economic and operating subjects, there will be a display of machinery and supplies, covering all the material and equipment needs of the industry.

THE cornerstone of the new petroleum engineering building at the University of Texas, to be built at the cost of \$200,000, has been laid. The formal dedication of the building will take place early this autumn.

ACCORDING to *Museum News* a new building is planned for the Army Medical Museum to replace the old brick structure at Seventh Street and Independence Avenue, Washington, D. C. Construction of the building was authorized by Congress in 1938 and the sum of \$130,000 was appropriated for the preparation of plans, which have been drawn by Eggers and Higgins. The proposed building, which will be started as soon as funds are provided by the Congress, will cost about \$3,750,000. It will be about 212 feet square in ground dimensions and will contain more than four million cubic feet of space. It will accommodate both the museum and the Army Medical Library.

THE Royal College of Surgeons, London, has received the sum of £40,000 from the Bernard Baron Trustees to endow a Bernard Baron research professorship at the college. A letter addressed to the president of the college by the trustees reads in part: "The scientific work which has formed such a notable part of the activities of the Royal College of Surgeons of England must and will continue. The trustees realize, however, that one of the essential sinews of your and their endeavor to benefit mankind is the provision of funds for the prosecution of research. They have therefore decided to make a gift of £40,000 for the endowment of a Bernard Baron Research Professorship at the Royal College of Surgeons, so that, whatever the difficulties with which the council may be faced in other directions, research will not suffer."

THE University of Sydney recently received a bequest of £60,000 for scientific research, general and unconditional, from the estate of the late Sir Hugh Denison.

It is stated in *Nature* that the University of Oxford is making a grant to the Department of Chemistry to carry out a nutritional survey and a study of anti-septics in relation to burns.

THE Museum of Northern Arizona, Flagstaff, has begun an extensive program of geological research

on fundamental problems relating to the Colorado Plateau area. Plans call for intensive and detailed studies to be conducted in several related fields, especially stratigraphy, structural geology and geomorphology. Work is already being conducted both by the museum staff members and by associates representing other institutions. The central location of the museum and its library and laboratory facilities favor it as a natural center for students interested in geological problems of northern Arizona.

It is announced that *The American Journal of Cancer*, edited by Dr. Francis Carter Wood, is now discontinuing publication because of lack of funds. It is reported that on account of the war there has been a considerable loss owing to the discontinuance of many European subscribers. This loss has been made up hitherto by the Chemical Foundation, which, however, has also been suffering a shrinkage of funds as the result of the expiration of important patents. The *Journal*, which has been issued monthly, was founded ten years ago by the late Francis P. Garvan, president of the Chemical Foundation.

THE Office of Information of the U. S. Department of Agriculture has issued a new list of agricultural workers in the land-grant colleges and experiment stations, as MP 420. It can be obtained from the Division of Publications.

THE name of the department of zoology at the University of Texas has been changed to "department of zoology and physiology." Funds have been provided by the university for the development of a comprehensive graduate program in biophysics.

THROUGH the cooperation of three transportation companies, the Pan-American airways, the Delta Line of New Orleans, and a third company, which requested that its name be withheld, there have been established four fellowships at the Louisiana State University, by which four young men of the Latin American Republics will be provided with fees, maintenance at the university and transportation from and return home at the end of the session. Dr. Robert H. Bradbury has been appointed director of a Division of Latin American Relations. The following have received fellowships: Alberto Raja Gabaglia, of Rio de Janeiro; Luis Fernando Moore, of Buenos Aires; José Serrano Martinez, of Quito, and Hugo Perez de Leon, of Guatemala.

A DECREE issued by the Argentine Government forbids for ten years the hunting of certain wild birds and animals which live in the Andes Mountains. These include the condor and several species of deer, which are said to have diminished alarmingly.

R. S. HUDSON, British Minister of Agriculture, has announced the appointment of an Agricultural Improvement Council for England and Wales, to devise methods for seeing that promising results of research are brought as rapidly as possible into ordinary farming practice. The council will advise from time to time on agricultural problems that seem to need scientific investigation. It will consist of a chairman and twelve members, appointed for three years with the possibility of reappointment, and will include practical farmers as well as distinguished men of science.

THE Universities Bureau of the British Empire has

announced the selection for the Rockefeller Foundation of medical studentships for the present year. These studentships have been awarded as the result of a grant by the Rockefeller Foundation of \$100,000 to aid the training in their clinical years of British medical students at a time when they may be deprived of the usual facilities. The amount of each studentship will cover the cost of tuition and living for two or three years. Between 90 and 100 applications were received and nearly two thirds of the candidates were interviewed. The 26 students selected are being sent to 19 universities in the United States and Canada.

## DISCUSSION

### THE CULTIVATION OF COTTON BY PUEBLO INDIANS OF NEW MEXICO

COTTON was cultivated by many of the Indian pueblos of the Rio Grande valley before the days of Coronado (1540).<sup>1</sup> It was used in the manufacture of textiles and also for ceremonial purposes. But the cultivation of cotton, except for ritual use (twine for prayersticks; to be placed unspun on the top of dance masks, etc.) has long since been discontinued. Early reports of the U. S. Indian agents do not mention the cultivation of cotton at all.

Very little is known about the botanical nature of the cotton cultivated by the Rio Grande pueblos. F. L. Lewton speaks of a specimen received from Mrs. Mathilda C. Stevenson, Española, N. M., which, he says, appears to be *Gossypium hopi*.<sup>2</sup> Where and when the specimen was collected and where it was deposited, if preserved, are not known. Dr. Elsie Clews Parsons reports that cotton is still cultivated at Jemez<sup>3</sup> and at Isleta,<sup>4</sup> but so far no report on identification of specimens from these pueblos has appeared.

In August, 1934, the writer collected a specimen of cotton from a garden at Ranchitos, the farming community of the Santa Ana Pueblo Indians which is located on the east bank of the Rio Grande just north of Bernalillo. Mr. Volney H. Jones, ethnobotanist in the Museum of Anthropology, University of Michigan, identified it tentatively as *Gossypium hopi* Lewton. The specimen has been deposited in the collections in Mr. Jones's custody (Catalog No. 14695). Late in the summer of 1936, Mr. Jones saw cotton under cultiva-

tion at Ranchitos and collected seeds. These seeds, together with those collected by the writer, were sent to the U. S. Department of Agriculture Field Station at Sacaton, Arizona, where plants from them have been grown annually since 1936.

R. H. Peebles, of the Field Station, who has examined these plants, reports, in correspondence, that this cotton, while quite variable, is similar to *G. hopi* in several taxonomically important respects. It is adapted to early flowering and fruiting, as is Hopi cotton. On the other hand, he notes that in certain characteristics the Santa Ana cotton diverges from *G. hopi*, and suggests affinity to Upland cotton (*G. hirsutum*). His conclusion is, however, that the "Santa Ana material is more closely related to *Gossypium hopi* Lewton than to *G. hirsutum* L."<sup>5</sup>

The following conclusions seem warranted: (1) The Santa Ana cotton and Hopi cotton have a common origin, that the cotton cultivated at Santa Ana to-day is a relic of aboriginal agriculture rather than a recent introduction from the cotton growing states of the Gulf coast region. (2) The minor differences in the morphology of these two (Hopi and Santa Ana) cottons are explainable in terms of differences in environment and, perhaps, differences in manner of cultivation (irrigation). (3) With regard to diffusion, the direction seems to have been from the Hopi country to the Rio Grande, rather than the reverse, since both cottons are adapted to a very short growing season and because the growing season at Santa Ana (196 days) is considerably longer than in the Hopi country (135 days). Our Santa Ana specimen is the only authentic and completely documented identification of cultivated cotton from an Indian pueblo in the Rio Grande region that has yet been reported, so far as we know.

LESLIE A. WHITE

UNIVERSITY OF MICHIGAN

<sup>1</sup> See V. H. Jones's exhaustive "A Summary of Data on Aboriginal Cotton of the Southwest" in "Symposium on Prehistoric Agriculture" (*The University of New Mexico Bulletin*, 1936).

<sup>2</sup> "The Cotton of the Hopi Indians: a New Species of *Gossypium*" (Smithsonian Miscellaneous Collections, Vol. 60, No. 6; 1912).

<sup>3</sup> "The Pueblo of Jemez," p. 14, 1925.

<sup>4</sup> "Isleta, New Mexico," p. 211, 1932.

<sup>5</sup> I am greatly indebted to Mr. Peebles and to Mr. Jones for their kindness and cooperation in this matter.

## THE PRESERVATION OF NATURAL AREAS EXEMPLIFYING VEGETATION TYPES

DR. VAN NAME's specific criticism of the United States Forest Service in the third and fourth paragraphs of his discussion, "Need for the Preservation of Natural Areas Exemplifying Vegetation Types" in *SCIENCE* of May 2, 1941, page 423, and in his reply to Dr. Baldwin, *SCIENCE*, July 18, is both inaccurate and unjust. Many of his statements are easily refutable by any one willing to make a fair and impartial examination of the facts.

Directly contrary to the statement which Van Name makes, the so-called "primitive areas" which the Forest Service has established do not have to "first pass a searching test for absolute commercial worthlessness before selection"; neither are they "nearly or quite treeless." The National Forest wilderness, primitive and roadless areas, which are now generally referred to as wilderness areas, were set aside to preserve primitive conditions of transportation and habitation in which the works of man would not intrude upon those desiring wilderness recreation. In accordance with good land use planning practice these areas, it is true, are largely in the high back country and care was taken to choose areas with no outstanding commercial values, but the areas do include millions of acres of timber land of all age classes and of many species and types. A considerable portion of this timber is mature and over-mature virgin stands, the low commercial value of which is the result of inaccessibility, not the condition or size of the timber, because much of it would be of great commercial value if it were more accessible. From a scientific standpoint, it does not appear that the low commercial value of this timber is any drawback since it is just as valuable for ecological study purposes as though it were worth \$10.00 per thousand board feet. National Forest Wilderness areas number 70 and include 14,000,000 acres, a very appreciable acreage certainly not indicative of lack of interest. A list of these areas and a map showing their location was published in *The Living Age* for July, 1940 (Vol. 5, No. 5).

More important from the standpoint of preserving natural areas exemplifying vegetation types, the point with which Van Name is primarily concerned, are the 41 natural areas on the National Forests, containing approximately 50,000 acres. Representatives of over 20 major forest types are included in this series. These areas are specially reserved to preserve permanently in an unmodified condition areas representative of the virgin growth of each forest or range type within each forest region so far as they are represented within the National Forests, to the end that its characteristic plant and animal life and

soil conditions, the factors influencing its biological complex, shall continue to be available for purposes of science, research and education.

The existence of these areas and the more than ten-year-old policy under which they have been established directly contradict Van Name's assertion that the United States Forest Service has failed to recognize its obligation to the American public in setting aside such areas. Although set aside to preserve for scientific study typical examples of major vegetative types, particularly timber, in a virgin or as near virgin condition as can be obtained, and not necessarily to preserve merely areas of large trees or high scenic value, these natural areas do contain magnificent examples of big trees and mature or over-mature stands of high scenic and inspirational value. A list of these natural areas will appear in an early number of *Ecology*.

As the writer stated last December, in a report before a joint meeting of the Committee for the Study of Plant and Animal Communities, and the Committee for the Preservation of Natural Conditions of the Ecological Society of America, at Philadelphia, the Forest Service does not consider the present system of natural areas within the National Forests as complete, and additional ones will be added. Suggestions from ecologists and other competent individuals and organizations as to desirable areas and types of vegetation needed for completeness will be welcomed. Nevertheless, the Forest Service does feel that the set of natural areas mentioned above, probably the largest by far set aside by any one organization with the primary purpose of preserving natural vegetation for scientific study, is a forward step which, incomplete though it may be, deserves the understanding and support of scientists, particularly ecologists.

I. T. HAIG

U. S. FOREST SERVICE

## MAN'S BIOLOGICAL OUTLOOK

IN recent issues of *SCIENCE*, Professor Eliot Blackwelder (April 18, 1941, pp. 364-366) and Professor H. D. Goodale (June 27, 1941, p. 618) have discussed the subject of man's probable future as a mammalian species. Professor Blackwelder asks the question (p. 366) ". . . will his [future man's] life and conduct be controlled by his intellect rather than by his feelings?" and Professor Goodale replies that recent work on animal and plant improvement "demonstrates that man holds his biological destiny in his own hands."

Neither of these writers, however, gives consideration to three factors in the problem of man's racial future that may be the most vital of all, namely (1) that man, physically and considered as a mammalian

species or genus, is one of the few living giants in the extensive group of mammals (Primates) to which he belongs, (2) that man's physical structure, both skeletal and visceral, has numerous well-known and much-discussed peculiarities that, like his gigantism, show him to be far advanced in the period of "phylogeronty" or racial old age, while (3), in his mental constitution man unites the dominating type of social behavior that is common to most anthropoid primates (well described by Yerkes and his associates) with such a unique genius for "implementing" it as to make the combination a totally new phenomenon in animal evolution. This combination may well prove to be, in the end, as racially lethal as the huge size and great bodily specialization of titanotheres, proboscideans and dinosaurs appears to have been in the past.

Though the idea of racial death as the normal end of every evolutionary line is not a new one, it is seldom given the place it deserves in the discussion of man's future. Professor Blackwelder alludes to it (p. 365), but Professor Goodale is silent on the subject. As an exception to this rule I may quote from an article entitled "A Palaeontologist Looks at Life," by Professor Herbert Leader Hawkins:

... The conclusion seems inevitable that simplicity is safe and complexity is dangerous. But if the main tendency of evolution is toward specialization then evolution leads inevitably to extinction. The rates of progress may vary, but the destination is the same. ... And yet there is nothing strange in the contention ... are we not aware that we [as individuals] are living in the constant anticipation of death sooner or later?<sup>1</sup>

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### THE LAW OF URBAN CONCENTRATION

ON page 19 of the July 4th issue of SCIENCE, E. L. Thorndike, in reviewing G. K. Zipf's book on "National Unity and Disunity," referring to his discovery

of the law of urban concentration, remarks, "This discovery may rank with Quetelet's discovery that the statures of men are distributed in accordance with the so-called normal probability curve."

This discovery is neither new, nor perhaps quite as striking as Professor Thorndike seems to indicate. That the size of cities and their rank when plotted on doubly logarithmic paper form essentially a straight line, seems to be first indicated by F. Auerbach, and was shown to apply to the cities of the United States in my book, "Elements of Physical Biology," 1925, pages 306-307. That a relation of this sort is not uncommon is a well-known fact, the outstanding example perhaps being Pareto's law of the frequency distribution of incomes. Another example is Williss's "Theory of Age and Area," as applied to the frequency of biological genera and species (see *loc. cit.*, pages 311, *et seq.*). Still another example is the Frequency Distribution of Scientific Productivity, as shown by me in the *Journal of the Washington Academy of Sciences*, 1926, Vol. 16, page 317. From this last source, I may quote the following sentence (page 323): "Frequency distributions of this general type have a wide range of applicability to a variety of phenomena, and the mere form of such a distribution throws little or no light on the underlying physical relations." This type of frequency distribution is, in fact, Pearson's type XI, a special case of type VI.

ALFRED J. LOTKA

METROPOLITAN LIFE INSURANCE COMPANY

DR. LOTKA is right in giving to Auerbach the credit that I gave to Zipf; and I apologize for my ignorance of Lotka's discussions of curves which use ranks and are based on the extreme value of the series. Very likely he is right also in regarding them as relatively unimportant cases of curves of extreme skew, but I still hope that they will be more than that.

E. L. THORNDIKE

## SCIENTIFIC BOOKS

### ENDOCRINOLOGY

*Endocrinology. The Glands and Their Functions.* By R. G. HOSKINS, M.D. 388 pp. New York: W. W. Norton and Co. 1941. \$4.00.

AMONG the many notable advances in the field of the biological sciences in the last fifty years none has been more spectacular than that relating to the endocrine glands. Unfortunately, much that has been written concerning these organs reflects more the enthusiasm of the investigator than it contributes to the advancement of knowledge, and this has been particularly true in the field of clinical endocrinology.

<sup>1</sup> *Proc. Cottswold Naturalist's Field Club*, vol. 33, pt. 3, p. 223, 1929, December, 1930.

While the remarkable effects of small quantities of certain hormones upon bodily function are a continued source of wonder, a full appreciation of their action is not gained unless the function of the endocrine glands is projected against the operation of the organism as a whole. Until it was clearly recognized that the endocrine glands operate as an integrated system, largely controlled by the anterior pituitary, there was a tendency to believe that they possessed an autonomy of action that set each individual member apart from the others. Even more deplorable was the undue emphasis placed on the hormone as an entity without recognizing that the tissue or tissues upon which it acts

form the second component by which endocrine activity is expressed.

The story of the endocrine glands has a close parallel with that of the vitamins. First, the recognition of the effects of deficiency, then the preparation of extracts that repaired the deficiency; then the isolation (and synthesis) of the active principle; and finally, in the case of vitamins but not yet in the case of the hormones, the identification of the cellular mechanism of which the active principle formed an essential part.

In the present volume the author has attempted the large task of writing a book that covers not only the fundamental knowledge of the endocrine glands as gathered by the experimentalist, but has also endeavored to point out the main clinical features of endocrine disorders in man. These, in themselves, would furnish material for a volume many times this size, but this book, in addition, deals in an interesting manner with the biological and teleological significance of these organs. As may be imagined, there is ample room for criticism on the grounds of omission and condensation of what may be regarded by some as essential material, but such criticism should be tempered by the avowed purpose of the book. It has been written for an audience as broad as its subject matter, "biologists, psychologists, premedical students, physicians and the intelligent general reader." Viewed in this light the author has produced a successful volume, one, indeed, that could have been written by few men and held such a universal appeal.

Dr. Hoskins may be termed one of the "pioneers" in the field of endocrinology in this country. He has seen the subject grow from the sincere efforts of a small group of men to place the study of the endocrine organs on a sound scientific basis to the honorable status it now holds as an important field in the biological sciences. He was one of the founders of the Association for the Study of Internal Secretions and the editor of *Endocrinology* for a long period of years. More recently, he has been the director of the Memorial Foundation for Neuro-Endocrine Research, another borderline field in which hardly the preface has yet been written.

In structure, the book takes up the endocrine glands in turn and after a brief historical outline discusses the work that led to the recognition of each as an organ of internal secretion. The isolation of the active principle, where this has been accomplished, is reviewed, however, with a minimum of the chemistry related to the details of the isolation or the identification of the active principle. The main physiological facts are usually given in good detail, and this is followed by a description of the principal clinical syn-

dromes associated with hypo- or hyperfunction of the organ in man.

To many the last two chapters on "Some General Aspects of Endocrinology" and "Endocrinology of the Future" will prove of especial interest. Here the author gives us his philosophical approach to the problem and outlines the major fields in which he anticipates future work will be done. Such chapters are not usually found in more formal text-books on the subject, but in this volume they are in keeping with the purpose for which it was written and for the audience it is intended.

Those with expert knowledge will find many places in the book that are lacking in detail, and in practically no instance will there be found detailed information of the experiments cited. However, these must be sought in the original articles, of which several of the most important are cited either at the end of each chapter or in the suggestions for further reading at the end of the book.

The reviewer, however, feels he must call attention to one gross contradiction. On page 180 it is clearly stated that the anterior pituitary hormones are of a protein character and are therefore destroyed by the digestive juices. Nevertheless, on page 173 there is reproduced the height and weight curve of a dwarf whose growth was alleged to be accelerated by the administration by mouth of anterior lobe substance. True, no comment is made in the text on the validity of these observations, but this chart does mar what is generally a conservative view of the value of this type of replacement therapy.

In conclusion, the author has succeeded in preparing a book that is eminently suitable for those who wish to obtain a broad picture of the development, present status and future possibilities of endocrinology, and he is to be congratulated on compressing so much readable material into such a small yet well-rounded volume.

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### THE THEORY OF NEWTONIAN ATTRACTION

*An Introduction to the Theory of Newtonian Attraction.* By A. S. RAMSEY. ix + 184 pp. Cambridge University Press. 1940.

THIS is a book of simple text, with many problems of practical interest to the student of applied mathematics. On the one hand it is a good preparation for Kellogg's "Foundations of Potential Theory," which is more precise and much more extensive on the theoretical side, and on the other, for the rich and systematic collection of problems in the Newtonian

Potential Function of B. O. Peirce, which many of us remember as young students. Ramsey's "Introduction" can be read profitably by persons who have mastered the second year of calculus in an American university.

The reviewer does not mean to say that the book is a mere routine selection of details of subject matter from more ambitious treatises. For example, the following topics will immediately excite interest: the condition that a family of surfaces be a possible family of equipotential surfaces; approximate formulae

for the potential of a body at large distances from it in terms of the principal moments of inertia, and the potential of a nearly spherical body, with applications to the attraction of the moon on the earth; the equilibrium of a rotating liquid, with Jacobi's ellipsoid of three unequal axes. The reader can thus expect to gain an introduction to several of the classical problems connected with the subject, as well as some systematic knowledge of the subject itself, in this very brief exposition.

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## SOCIETIES AND MEETINGS

### THE AMERICAN ASSOCIATION OF BOTANICAL GARDENS AND ARBORETUMS

At the annual meeting of the American Institute of Park Executives, in September, 1940, a new organization was formed, to be made up of those connected with arboretums and botanical gardens situated in North America. Though this organization is still very young, it has at present approximately seventy members, representing approximately fifty-four different arboretums and botanical gardens in North America. Its purpose is to promote the interests of botanical gardens and arboretums and to promote the interest of the general public in living plants.

The official organ is the magazine *Parks and Recreation* in which the association has a monthly section, at present consisting of descriptions of the various botanical gardens and arboretums in North America, their objectives and methods of conducting research projects. Also in this section appear various news notes and interesting items concerning rare or unusual plants. This is part of the work of the publication committee, the chairman of which is Henry T. Skinner, curator of the Morris Arboretum, Chestnut Hill, Philadelphia.

The chief undertaking of the association at this early stage is the assimilation of a complete list of plants of a few genera which are growing in this country at the present time. For instance, many a botanical garden has a collection of oaks, maples, junipers, rhododendrons or honeysuckles. Some of these have been collected from many foreign sources, and without the aid of complete inventories from each institution, it is impossible to comprehend exactly what plants are growing here in this country. Naturally, some collections are more complete than others, but it may well be that hidden in the smaller collections are some rare species and varieties, not known to exist in this country. With the increasing uncertainty of foreign

horticultural contacts, it becomes more and more important to take stock of what plants are being grown here in the western hemisphere. It is to obtain an inventory on plants in North America that this method has been adopted. The problem will be attacked genus by genus and will take years of painstaking effort, but the idea is a sound one, and it is hoped that the various botanical gardens and arboretums will be sufficiently interested to cooperate in this undertaking and help make it a success. It is not anticipated that all genera will be included, but it is hoped that much will be learned about those genera studied in this way.

There are several other possibilities of cooperation among the members of this new organization. In the first place, it is hoped that some method may be worked out whereby a competent group of judges can be selected who will inspect various collections consisting of one genus or even one species, and report on "the best" for ornamental purposes. An example would be in the case of *Syringa vulgaris*. There are over 300 varieties of the old-fashioned lilac in America to-day, over 150 of them being offered by nurseries. Certainly all do not have outstanding ornamental characteristics. It would be the purpose of this judging committee to study such large groups of lilacs as exist in America, and make recommendations of what would constitute the 10 (or 15) "best" white varieties, the best pink varieties, and so forth, the idea being to help the general public and the commercial growers, in spending time only with those varieties which have demonstrated their superior qualities. This same group of judges, or another like it, could investigate the daffodil, iris and peony collections in the country. Truly an ambitious program! Yet some organization should at least contemplate the possibilities of such a plan, and it is hoped the new Association of Botanical Gardens and Arboretums can work out some recommendations which will prove practical in attempting to tackle the problem.

It is also the purpose of the organization to pub-

licize certain noteworthy plants rarely grown in America at present. Then, too, some mutual system of dissemination of propagating material will be considered, together with plans for certain cooperative hardiness tests. It will be seen that these ambitious plans will take much time to complete, but certainly form the basis on which there can well be a firmer bond between the botanical gardens and arboreta of America.

The officers of this new association are: *Director*,

C. Stuart Gager, Brooklyn Botanic Garden, Brooklyn, New York; *Director*, Henry Teuscher, Montreal Botanical Garden, Montreal, Canada; *Chairman*, Donald Wyman, Arnold Arboretum, Jamaica Plain, Massachusetts; *Vice-chairman*, Henry T. Skinner, Morris Arboretum, Chestnut Hill, Pennsylvania; and *Secretary*, C. E. Godshalk, Morton Arboretum, Lisle, Illinois.

DONALD WYMAN,  
*Chairman*

## SPECIAL ARTICLES

### DIETARY REQUIREMENTS FOR FERTILITY AND LACTATION. XXX. ROLE OF p-AMINO BENZOIC ACID AND INOSITOL IN LACTATION<sup>1</sup>

#### PRELIMINARY REPORT

RECENTLY I have reported<sup>2</sup> that such large daily doses as 120  $\mu$ g thiamine, 120  $\mu$ g riboflavin, 120  $\mu$ g pyridoxine, 15 mg choline chloride, 600  $\mu$ g calcium pantothenate, and "W" factor from 1 gm liver extracts (nicotinic acid having been provided in the ration), as a source of the vitamin B complex, resulted in complete failure in lactation of the albino rat, the infant mortality being 95 to 100 per cent. Apparently some dietary factor was missing that is essential for lactation. The missing factor, tentatively designated as "Bx," was found in rice polishings, defatted wheat embryo, dried grass and brewer's yeast, but most abundant in liver and rice bran extracts. A potent concentrate was prepared from the residue of the "W" factor extract by adsorption on fuller's earth. The "Bx" factor was found in the filtrate. On the daily allowance of this concentrate, which was the equivalent of 2 gm of the original liver extracts, 5 mothers successfully weaned 33 out of 34 young given them to rear. The litter of one mother, however, reached maintenance on the 15th day of lactation and maintenance persisted for 7 days. Another litter showed loss of weight on the 17th day and maintenance on the succeeding 3 days. The recent reports of Ansbacher<sup>3</sup> that p-aminobenzoic acid is a chromotrichia factor for the rat, and that of Wooley<sup>4</sup> that inositol is an antialopeia factor for the mouse; also, the report of Pavcek and Baum<sup>5</sup> that inositol is an

antispectacled and growth-promoting factor for the rat warranted the trial of these substances. The results with daily doses of 15 mg p-aminobenzoic acid were negative. A daily dose of 30 mg inositol resulted in a prompt response in the case of the first mother, i.e., a gain of 16 gm in 24 hours, and 33 gm in 48 hours in the weights of the litter, and the litter was weaned in 8 days subsequent to the inositol administration. The response to the inositol administration in the case of the second mother was similar.

It was then decided to attempt to rear nursing young of the albino rat on only known pure chemical substances of the vitamin B complex. For this reason the "W" factor was removed from the females at mating. The experiments were conducted in three series, and the following daily additions to the vitamin B complex mixture were given to the mothers during pregnancy and lactation: (1) 15 mg p-aminobenzoic acid; (2) 30 mg inositol; (3) 15 mg p-aminobenzoic acid and 30 mg inositol. The results obtained to date on reproduction and lactation are as follows: Series 1: Out of 92 young born there were only 3 dead, or 3.3 per cent. stillbirths. Out of 53 young given 9 mothers to rear, 32 were weaned. Series 2: Out of 5 litters, 2 were born dead. Two mothers failed in lactation with litters of 6 each. One mother weaned 5 young. Per cent. of stillbirths was 30. Series 3: Out of 46 young born to 5 mothers there was only one stillbirth. Out of 28 young given 5 mothers to rear, 22 were weaned.

It appears from the character of results obtained in this investigation that p-aminobenzoic acid should be added as an essential dietary factor for the rat, as evidenced from studies on reproduction and lactation. It would also seem from the data submitted that the "Bx" factor either contains p-aminobenzoic acid or a substance of similar physiological properties. Further experiments will determine whether inositol is also to be considered a dietary essential for lactation and reproduction of the rat.

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<sup>1</sup> Research paper No. 698, Journal Series, University of Arkansas. Published with the approval of the Director of the Arkansas Agricultural Experiment Station. Aided by a grant from the Committee on Scientific Research of the American Medical Association.

<sup>2</sup> *Proc. American Soc. Biol. Chem.*, Chicago, Ill., April 15-19, 1941.

<sup>3</sup> S. Ansbacher, *SCIENCE*, 93: 164, 1941.

<sup>4</sup> D. W. Wooley, *Jour. Biol. Chem.*, 139: 29, 1941.

<sup>5</sup> P. L. Pavcek and H. M. Baum, *SCIENCE*, 93: 502, 1941.

### HEARING IN THE RAT AT HIGH FREQUENCIES

THE authors recently discovered that rats sometimes display epileptiform seizures when they are exposed to frequencies of 21 kilocycles and that they show, by their overt behavior, sensitivity to even higher frequencies. It therefore seemed clear to us that the rat hears higher frequencies than does man, but it became a matter of interest to know just what frequencies are audible and how well these frequencies are heard. No data concerning pure tones higher than 8 kilocycles could be found in the literature, so the following experiment was conducted.

Nine rats were taught to run from one part of a compartment to another whenever a tone of 8 kilocycles was presented. Their incentive was to avoid shock. When they had learned this, they were trained to react in similar fashion to other frequencies between 1 and 40 kilocycles. Then the intensity of the tones was reduced step by step until an intensity was reached at which a tone called forth responses from the animal only 50 per cent. of the time. This intensity was taken as the threshold, and it was determined for 1, 2, 4, 8, 14, 21 and 40 kilocycles. (40 kilocycles was the limit of our apparatus.) Except for 21 and 40 kilocycles, similar measurements were taken on eight human subjects.

The average thresholds of the human and animal subjects were compared at different frequencies with the following results. The rat's threshold is much higher than man's at 1 kilocycle, but the difference between the two diminishes as the frequency is increased, until in the neighborhood of 8 kilocycles the sensitivities of man and the rat are the same. At higher frequencies, however, the rat is more sensitive than man, and the discrepancy becomes larger as the frequency is increased. Thus rats are poorer than man below 8 kilocycles and better than man above this frequency.

Any attempt to state the audiogram of the rat in terms of acoustic energy must be based upon somewhat tenuous suppositions concerning the physical characteristics of our apparatus. Nevertheless, even when due account is taken of such considerations, we can state that the absolute sensitivity of the rat most certainly improves as the frequency is increased up to 20 kilocycles. It seems likely, furthermore, that the frequency most audible to the rat is as high as 40 kilocycles. At any rate, our rats hear 40 kilocycles very well, and the upper limit of hearing must, on this account, be a very high frequency indeed.

No animal in whom hearing has been studied at all adequately presents such a disposition of auditory sensitivity as this. Cats and dogs<sup>1</sup> hear best at a

<sup>1</sup> S. Dworkin, J. Katzman and G. A. Hutchison, *Jour. Exp. Psychol.*, 26: 281, 1940.

higher frequency than man, and their upper frequency-limit is higher, but the rat surpasses them in both respects. Of other animals so far studied, only the bat<sup>2</sup> shows signs of possessing a similar range of auditory sensitivity; cochlear potentials have recently been observed in this animal up to 98 kilocycles. If more suitable sound-producing instruments than we had at our disposal are available in future experiments, it may be shown that the rat's hearing extends to and beyond this frequency; at least, so our data would lead us to expect.

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### THE GERMINATION OF MAIZE POLLEN

THE pollen of *Zea mays* is recognized as one of the difficult sorts to germinate under artificial conditions. In addition to its value in genetic and cytological studies, preliminary experiments have suggested that a reliable method for rapidly checking the viability of maize pollen will be necessary in studies of the effect of ecological factors on pollination and yield of maize.

A method has been developed which has given as much as 90 per cent. germination on nutrient medium within 30 minutes after inoculation. A solution containing 0.7 per cent. agar and 15 per cent. sucrose is held at 60 degrees C. in a water bath and transferred with a pipette to a microscope slide. Only enough solution is placed on the slide to form a shallow droplet of approximately 1 cm diameter. The droplet is allowed to harden for 60 seconds at 20 to 25 degrees C. before the pollen is dusted on from a knife blade held about 2 cm above. The slide is immediately transferred to a moist chamber at 23 degrees C. in which the relative humidity is maintained at 90 per cent. Germination counts can be made after 30 minutes, and, with good lots of pollen, should certainly be read within two hours, before a confusing mass of tubes has developed. In practice the tube growth has been arrested by transferring the slides after two hours to another moist chamber at 6 degrees C. in which the material can be preserved intact for two weeks for more leisurely observations.

The most serious problem in germinating maize pollen is the prevention of bursting. Apparently a near isotonic relationship between the nutrient medium and the cytoplasm is required, with the balance slightly on the hypotonic side so that the pollen grain may absorb water for tube growth, but not rapidly enough to cause bursting. With different lots of highly viable pollen the sucrose percentage showing maximum germination has varied between 10 and 15 per cent. Although no sugar determinations have been made for

<sup>2</sup> R. Galambos, *SCIENCE*, 93: 215, 1941.

maize pollen, grains treated with an alcoholic solution of IKI reveal wide differences in starch content. It may well be that ecological conditions prior to pollen shedding influence the sugar content of the grains. It is not known whether a reduced osmotic value in the grain is due to the use of some of the sugars in increased respiration or whether sugars may be readily changed to insoluble forms and thus play no part in the osmotic force of the cell. More consistent results

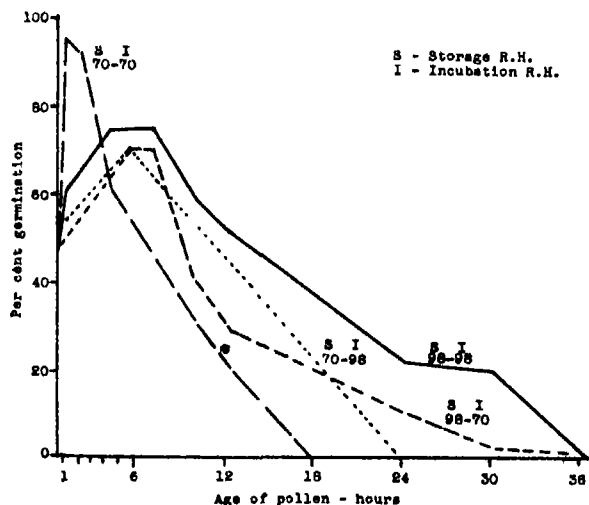


FIG. 1. Effect of age and relative humidity during storage and incubation on the germination of maize pollen.

have been obtained when pollen was taken from cut tassels stored overnight to several days at constant humidity and temperature, perhaps because more uniform osmotic values are obtained with such preliminary treatment.

A major factor in the success of the method is the degree of imbedding of the pollen grains in the still soft agar, and the agar percentage, temperature and

cooling rate are important in this connection. Best results have been obtained when the grains were two thirds imbedded and one third exposed to the air. Presumably these conditions favor absorption of both water and oxygen. Covering the pollen has prevented germination. Germinating at 90 per cent. rather than higher humidity reduces bursting due to the formation of free moisture films on the agar. Good germination has been obtained in many experiments at 60 per cent. humidity, although shorter tubes were produced in the drying agar. The data of Fig. 1 show that germination under artificial conditions improved with storage for about six hours after shedding, then declined rapidly. One lot of pollen remained viable after 10 days storage at 8 degrees C. Longer storage life was obtained at the higher humidities, but many lots of pollen stored in nearly saturated air suddenly appeared to become moist and to clump together and thereafter showed no germination.

Maize pollen has germinated poorly on fructose and progressively better on glycerine, glucose and sucrose used at equivalent molarities. Tubes have been produced at pH 4.0 to 8.4. Under optimum conditions the elongation of the pollen tube is sufficiently rapid to be plainly visible under the microscope, and when projected on a screen by a micro-projector so that the grain appeared as large as a grapefruit, the image of the growing point has progressed as much as 1 cm a minute. Tube lengths have frequently reached fifty times the diameter of the pollen grain, although no attempt to stimulate tube growth, as distinct from germination, has been made.

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## SCIENTIFIC APPARATUS AND LABORATORY METHODS

### THE DAILY REMOVAL OF FORMALIN FROM PRESERVED BIOLOGICAL SPECIMENS USED IN CLASS WORK

INSTRUCTORS and students who are exposed repeatedly to the formalin contained in preserved biological specimens often find their laboratory periods extremely disagreeable and, occasionally, hazardous. Induction or aggravation of the common cold, severe dermatitis, bronchitis and asthma are the chief hazards of exposure to formalin. A method is needed to remove this common laboratory preservative.<sup>1</sup>

Dr. Foust, *et al.*,<sup>2</sup> reported the value of a 5 per cent.

<sup>1</sup> P. H. Pope, *SCIENCE*, 73: 495, 1931.

<sup>2</sup> H. F. Foust, T. S. Leith, H. M. Tabbut and L. Bowstead, *SCIENCE*, 83: 498, 1935.

urea and 1 per cent. ammonium phosphate solution in removing formalin from preserved specimens. Following the directions given in this article, the writers attempted to deformalinize bullfrogs, dogfish, starfish, etc., but failed to obtain satisfactory results. Therefore, we sought to develop another method to achieve the desired result.

After making a series of small-scale tests with some forty laboratory reagents known to react with formalin, we selected sodium bisulfite,  $\text{NaHSO}_3$ , as most closely approximating our objective, *viz.*, of finding a convenient, quick, cheap and efficient method for removing formalin. An aqueous solution of this reagent was entirely suitable in so far as it completely destroyed the formalin odor of preserved specimens

immersed in it within 3 to 5 minutes. The largest specimens required the greatest length of time.

However, because of the acidity of the formalin resulting from the presence of formic acid, sulfur dioxide gas,  $\text{SO}_2$ , was liberated from the  $\text{NaHSO}_3$  solution in such quantities as to nullify its usefulness in a classroom procedure. It appeared that this source of  $\text{SO}_2$  could be eliminated simply by reducing the H ion concentration of the reactant solution. This was accomplished by buffering the solution with  $\text{Na}_2\text{SO}_3$ .

We may now detail the essential points in the preparation and use of the sulfite-bisulfite solution:

(1) The deformalinizing solution contains 5.7 per cent. (by weight) of  $\text{NaHSO}_3$  and 3.8 per cent. (by weight) of  $\text{Na}_2\text{SO}_3$  dissolved in tap water. A deviation of 1 to 5 per cent. from the above figures would probably introduce no serious failure of the solution to function properly. It is our experience that 20–30 liters of the solution will last a full semester in the daily removal of formalin from any specimens in use in a zoology class of 35 students. To prepare 20 liters of solution dissolve 1260 grams of  $\text{NaHSO}_3$  and 840 grams of  $\text{Na}_2\text{SO}_3$  in tap water.

(2) Specimens removed from their formalin bath are given a brief preliminary rinsing under the tap, and then immersed in the sulfite-bisulfite solution from 3 to 5 minutes. As many specimens as can be conveniently handled may be deformalinized simultaneously. Following a final quick rinse, the specimens are free of formalin odor and ready for dissection. Large specimens or those which may have been injected with various formalin mixtures may require subsequent short immersions as dissection proceeds.

(3) Failure of the solution after repeated usage to remove the formalin promptly may require the addition of more  $\text{NaHSO}_3$  just short of the point where  $\text{SO}_2$  gas is evolved. Evidence of  $\text{SO}_2$  arising during the routine employment of the solution calls for the addition of small amounts of the  $\text{Na}_2\text{SO}_3$ . There is a considerable variation in the actual amounts of  $\text{NaHSO}_3$  and of  $\text{Na}_2\text{SO}_3$  in the technical grade of these chemicals. This should be kept in mind and the amount of one or the other reagent increased as may be necessary to give a satisfactory solution. A pH determination of the solution gives a reasonably easy method of ascertaining if it has been properly prepared. The solution of the concentration specified has a pH of about 6.4. One containing insufficient  $\text{Na}_2\text{SO}_3$  and which may therefore evolve sulfur dioxide, will have a lower pH. One containing an excess of  $\text{Na}_2\text{SO}_3$  will have a higher pH.

(4) Although certain specimens, frogs for example, may be stored for several weeks in the reactant solution without impairing their dissecting qualities, others such as the dogfish become soft after 5 to 6 days and

unsuitable for dissection. In other words, the solution is not a substitute for formalin. After the removal of the formalin, the specimen may be kept in any other satisfactory preservative, or returned to formalin.

(5) The solution should be kept in common glazed earthenware laboratory crocks, as it will slowly attack metal containers.

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### A SIMPLE METHOD FOR REMOVING THE PLUNGERS OF "FROZEN" GLASS SYRINGES

THE method of removing the plungers of "frozen" glass syringes suggested by Goff in *SCIENCE*, Vol. 93, page 602, was of much interest to us. While we make no claim whatever to originality, we feel justified in calling attention to the method of removing the plungers of "frozen" glass syringes used in our laboratory, because of its simplicity and usefulness, and because many persons are unfamiliar with it.

All that is required is a syringe with a plunger of lesser diameter than the plunger of the "frozen" syringe, and equipped with a short hypodermic needle. We often use a 1 cc Yale tuberculin syringe. The needle passes through a small bit of rubber, such as a piece of a wide rubber band which acts as a gasket. The tuberculin syringe is filled with water, and the needle inserted into the outlet of the "frozen" syringe, the piece of rubber making an airtight seal. Water is then forced from the tuberculin syringe into the "frozen" syringe, until the plunger of the latter is free. It may be necessary to fill the tuberculin syringe with water a number of times, but the method almost never fails.

AUGUSTA B. MCCOORD

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## PROBLEMS CONFRONTING MEDICAL INVESTIGATORS<sup>1</sup>

By Dr. WALTER B. CANNON

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IN relation to their special concerns men of science face problems of two sorts. First, there are the enticing direct questions, presented at the outer boundaries of existing knowledge, as to what may lie just beyond. Many investigators in astronomy and biology, for example, have had their imagination stirred by such questions. To satisfy their curiosity they have striven persistently for more facts. And the facts have led to understanding of the vastness of interstellar space

and the immense duration of evolutionary processes. But these facts have had an impact on society which has led to profound changes in the outlook and judgment of all thoughtful people. The revolutionary social effects of advancing science raise the secondary, more indirect questions regarding the significance of scientific progress for humanity. Such questions, also, challenge scientific workers, as they challenge other intelligent members of the body politic.

In the present essay our attention will be directed in the main to the primary professional questions awaiting medical investigation. Before they are considered, however, it may be well to note that the social effects of progress in medical knowledge appear to

<sup>1</sup> A contribution to a symposium on "The University and the Future of America," held at the celebration of the fiftieth anniversary of the founding of Stanford University. It will appear in a volume containing all the addresses given at the symposium, to be published by the Stanford University Press.

be of such favorable nature as to permit it to escape the harsh strictures sometimes drawn against science in general. If this is true the promotion of medicine by research should be commonly recognized as set apart in a special class, where frank encouragement should prevail rather than any aversion or hostility. Let us see what could possibly justify the unqualified support of medical investigators.

The question whether the advancement of science has not done more harm than good has been raised increasingly of late by apprehensive observers. New powers have wrought such havoc and destruction that men begin to fear the acquisition of new knowledge. Unable to check its perversion to evil purposes they propose to stop, at least for a while, further scientific progress. No one has expressed more vividly this terror of fresh discoveries in the world of nature or laid upon scientific endeavor a more sweeping curse than George Gissing. "I hate and fear 'science,'" he wrote, "because of my conviction that for long to come if not for ever, it will be the remorseless enemy of mankind. I see it destroying all simplicity and gentleness of life, all the beauty of the world; I see it restoring barbarism under a mask of civilization; I see it darkening men's minds and hardening their hearts; I see it bringing a time of vast conflicts, which will pale into insignificance 'the thousand wars of old,' and, as likely as not, will overwhelm all the laborious advances of mankind in blood-drenched chaos."

This terrific indictment, one may justly assert, does not apply to the science of medicine. By the careful studies of medical investigators devastating pestilences, which formerly spread terror through great populations, have been wholly abolished. No longer do we witness such scenes as Defoe reported in his description of the disastrous plague in London in 1665—"people in the rage of the distemper or in the torment of their swellings, which was indeed intolerable, running out of their own government, raving and distracted and often times laying violent hands upon themselves, throwing themselves out of windows, shooting themselves, mothers murdering their own children in their lunacy." The extinction of such horrors by scientific effort should certainly mollify, if not refute, the bitter charge that science is "the remorseless enemy of mankind."

And many another beneficent triumph of medical research can be cited. Ravaging and distressing diseases, such as typhoid fever and diphtheria, have been all but wiped out. Increasing control of malaria, yellow fever and hookworm has not only lessened greatly the misery of myriads of human victims but has rendered safely habitable by man large areas of the earth where once he dwelt only at his deadly peril. Tuberculosis, long "master of the kings of death," has been

dethroned; and the apathy of ignorance and despair toward it, formerly felt by both the victim of the disease and the helpless doctor who attended him, has changed to hope and cheer. Lying-in hospitals, from which at times as many as a third or a half of the mothers were carried away dead of child-bed fever, are now havens of safety and helpfulness. The conquest of surgical sepsis has enabled the surgeon to apply his skill to any part, to belly, chest or brain, in order to repair damaged structure, remove dangerous new growths or deal effectively with invasion by harmful germs. Precise studies of the ways in which the organs of the body collaborate to perform their functions have revealed the marvelous nicety of the adjustments of means to ends, and have established reliable standards for quick recognition of disorder. Aided by delicately discriminative devices—the x-rays, electrical registration of the heart beat, tests of functional capacity of various organ systems—the physician now enters the sick room with deeper insight and a more reasonable confidence of being able to learn the nature of the complaint than his predecessors could possibly have possessed.

These successes in solving the complicated problems presented by human beings in their relations to one another and to lower animals, to their shifting environment and their microscopic foes, have given medical investigators well-justified confidence in the efficacy of scientific methods. The repeated sequence of well-based ideas, and cautious experimental tests, and limited inferences, that has characterized the victorious advance of medical science, will, they firmly believe, continue to bring forth desired results—results ultimately useful in the relief of man's estate.

There is need for this confidence, because many serious problems remain to be solved. Some of them, cancer, for example, have long been impressive and insistent. Others have become more prominent as a consequence of medical research itself. Due to various conditions—and especially to improved medical care—the population of the world has doubled during the past hundred years. Vast numbers of people have gathered in immense cities where they live their stressful days in a manner sharply different from that of ancestral custom. The great cities permit concentrations of workers in huge industrial plants—specialized workers dependent for their daily bread on a precarious daily wage. The age structure of our population has been much altered. Formerly, the high birth rate and a continuous arrival of young immigrants made us a relatively youthful people. Since 1900, however, the birth rate in the United States has dropped more than one third, and immigration has been drastically reduced. Accompanying these changes there has been a falling death rate extending

to the sixth decade of life and therefore an increasing number of the elderly in the population. Specialization of labor, insecurity of remunerative position and an altered distribution of age groups all collaborate to present new questions for medicine to answer.

An ideal service which a university may perform for society is that of welcoming new ideas, examining them critically, evaluating them so far as possible without prejudice, and stating clearly their implications and the probable consequences of putting them to practical use. The medical department of a university should participate in these obligations. Its leaders should note the trends of social change as they may affect the demands on the medical profession, and should prepare to meet those demands with intelligence and skill. Let us consider some of the more important problems which are presenting themselves, in order that we may learn what should be done.

First, we may examine the shift of age groups already mentioned. In Sweden, where careful records have long been kept, the average length of life, late in the eighteenth century, was 34.5 years, a figure only slightly higher than that estimated for ancient Roman times; by 1840 it had increased by 7 years, and now, after decades of applied measures of public health, the increase is 28 years—from 34 to 62. Similar changes have occurred in our country. The recent speed of development of this highly significant phenomenon is illustrated in the reports of a large American life insurance company. During the quarter-century between 1912 and 1937 the life expectancy of its *industrial* policy holders advanced from 45 to 60 years—an advance of 33 per cent.—and the prospects of the general population are even better. This means that we must prepare for a future in which a larger proportion of our people than at any time in past history will reach at least threescore years in their life span. In England, between 1901 and 1937, the percentage of individuals over 60 rose from 7 and a fraction to 13, an increase of nearly 80 per cent. It is conservatively estimated that if present trends in the rates of birth and mortality continue in our country, and they bid fair to do so, by 1980 more than 14 per cent. of our population will be 65 years of age or older—approximately 22 millions instead of the 3 millions (or 4 per cent.) of forty years ago.

Besides the social, economic and industrial problems which the current increase in the number of the aged imposes there are medical problems which, though long recognized, have been long neglected. As one grows older the fires of life burn less vigorously and the adjustments of bodily organs to emergencies tend to be impaired—the breath is shorter, the heart beats less effectively, the blood pressure gradually rises as

the years pass and becomes ill adapted to critical requirements. Are these features essential attributes of the elderly or are they the consequences of comfortable and habitual indolence? We know that in middle age some of these effects may result from inactivity alone and that they can be reversed by training. In the later decades, also, could they be altered by effort? Should attempts be made to alter them? What would be the effects if they were altered? These questions offer possibilities of useful research.

Then there are the characteristically different diseases in the older members of society as compared with the younger members. Chronic disorders, starting insidiously and creeping onward until they overwhelm the working ability of the victim, are not infrequent. Thus, impaired functions of the heart and kidneys, the limitations set by diabetes, the ravages of cancer, the stiffening of the arterial vessels in the brain and elsewhere accompanied by reduction of the blood supply to the tissues and by dangers of shock and paralysis—these and other persistent afflictions are likely to replace the infectious diseases encountered in earlier periods, as hazards to existence.

The mortal attacks on indispensable structures of the body—on heart, brain and kidneys—are not the only calamities of old age. These attacks do, indeed, kill. There are others, less dangerous, which sorely torment. "Rheumatism" itself and its commonly assumed guises (neuritis and lumbago, for examples), chronic inflammation of the bronchial tubes, asthma, persistent itching, which are not unusual distresses in the elderly, can render the period of senescence wearisome and miserable. Confronting such possibilities the middle-aged are naturally apprehensive as the years draw nigh when, it is said, one has no pleasure in them.

Here is a complex group of very difficult problems calling for solution. Almost none of the most prominent disorders of senescence is understood. The prevailing ignorance, we may assume, is largely due to lack of systematic study. We may reasonably expect that geriatric research, the application of scientific methods to the disorders of senescence, will reveal their nature, the conditions which induce them and the possibilities of diminishing their incidence and their injurious effects. Death, of course, must come when one or another vital organ fails its duties, but while life lasts no effort should be spared to make it a good life. Medical investigators have much to learn about how to maintain health and preserve a satisfying ability to be useful in the growing numbers of their fellows who reach the seventh decade and beyond.

In order to catch the early signs of defect reliable measures of physiological fitness are needed. Critical tests must be devised which will reveal the ability of

the organism to withstand stresses at different periods in the span of years. Criteria for judging the degree of perfection of the protective and corrective devices of our bodily economy must be established. Early infections, early injuries (both psychic and physical), early malnutrition or hygienic neglect in relation to the decrepitude of the last decades must be studied as carefully and thoroughly as possible. This will be a protracted, exacting and expensive program. University medical schools should take up the challenge and set forth in an attempt to give to the people of our country, since they are to have a longer life, the assurance that they shall have it more abundantly.

Severe demands on the nervous system, which have become progressively more severe in the recent past, have had results calling for medical attention. The conditions which have arisen may be in part the accompaniment of a remarkable shift in the occupations of our citizens. From a population 60 per cent. rural in 1900 we have become a population 60 per cent. urban. In that overturn the cities have gained from the farms more than 30 millions of inhabitants. The admirable liberty, independence and opportunity for self-direction, which typify the pursuit of agriculture, have to a large degree been exchanged for a routine of fixed hours, monotonous tasks and a sedentary existence which breaks in sharply on the ancient racial habit of using the big muscles of the body for earning one's daily bread. Furthermore, as hired hands—bookkeepers, clerks and accountants, or as operatives in foundries and factories—city dwellers become entangled in the wide-spread web of dependency. Labor strikes, business failures and revolutionary inventions involve familial tragedies of lost jobs, wrecked plans and broken homes. The intense drive and pressure of the new life, its worries and its dreads, place a burden upon men and women which often is too great to be borne. The strain is mirrored in the rise of the suicide rate of the United States during the years of excitement and depression near the beginning of the last decade. It went steadily upward until, in 1932, it was over 50 per cent. higher than during the five years after the first World War. That rise meant an increase of more than 6,000 suicides in 1932 alone.

While the stresses which affect the nervous system have been on the increase since the turn of the century, the seriousness of infections has been undergoing a remarkable decline. To this altered situation medical science has been slow in adjusting itself. The technique required for understanding nervous influences is novel and not well developed. A disorder of the brain may fail to reveal itself at the autopsy table or under the microscope. And yet emotional

upsets, which leave in the nervous pathways no visible trace, have concrete and obvious effects, and may be the occasion for profound misery and suffering. Obsessive fears disturb or interrupt digestion, alarmingly accelerate the heart, send the blood pressure oscillating in hot flushes or impress a deep and stubborn sense of agitation. The poor patient, not finding sympathy and interest elsewhere, may take his troubles to faith healers or to other cultists who are attentive and who confidently promise aid. It is stupid to belittle or neglect such complaints. The powerful influence which emotional states can exert on bodily functions needs no argument. The ways in which the processes of the brain produce disturbances, however, are little comprehended; and the devices which might be employed for prevention or cure have not received the scientific attention which their importance demands. The problems which are posed are especially difficult because, in the brain more than in any other organ, man differs from the lower animals. For that reason studies on the lower forms are suggestive rather than conclusive. It will probably be necessary, therefore, that medical investigators of the neuroses, while maintaining a firm basis in physiology, shall rely on the clinic in order to find subjects for their research.

Closely associated with the mysteries of nervous instability is the most complex of all medical problems, that of mental derangement. The custodial care of the insane has immeasurably improved since St. Mary's of Bethlehem in London gave the English language the word "bedlam," and decades have passed since the wretched victims of a diseased mind were chained in outhouses and treated like wild animals. Nevertheless, in the great asylums custodial care continues to be almost the only type of treatment. And meanwhile the problem grows constantly greater and more startling. The numbers of the mentally afflicted who have been safeguarded by the State of New York rose from 390 per 100,000 in 1920 to 525 in 1938, an increase of nearly 35 per cent. in 18 years. And the appalling fact is now disclosed that as the age range lengthens, there are more and more victims of mental disease for whom protection is necessary. For example, between 1912 and 1936 the population over 40 years of age in the United States rose about 6 per cent. During that period the first admissions of patients over 40 years of age into the mental hospitals increased from about 8 to 49 per 100,000, an increase of more than 500 per cent. Half of the hospital accommodations of the country are devoted to the insane; and it is estimated that one fifth of all hospital beds are occupied by sufferers from a single mental disorder, schizophrenia. Hundreds of millions of dollars are spent every year—New York alone voted more than thirty-one millions in 1938—mainly to pro-

vide a place of refuge for the mentally diseased. Wards are extended and new buildings are erected in order to accommodate the growing numbers. Meanwhile, only relatively trifling sums are being devoted by the states to learn preventive measures by which the incidence of mental derangements may be lessened, or to discover methods which could be used to treat these derangements effectively. The outlook is not hopeless. Within the past score of years an apparently intractable disorder of the brain, general paresis, often associated with most fantastic delusions, has yielded to artificial fever and can thus be cured. Furthermore, new modes of bringing back to lives of sanity and realism persons plunged in apathetic indolence or futile day-dreams are now being tried, with a promising proportion of remarkable successes. The stupendous personal, familial, social and economic importance of the problems of psychiatry calls urgently for the labors of many well-disciplined medical investigators, devoted to research in this field.

The gradual onset of disabilities, bodily and mental, in the later years of life demands long-range studies on the possible influence of inheritance, early injuries, severe infections in childhood and youth, frustrated plans, the demands of labor and probably many other conditioning experiences. Because we each become more and more individualized as we grow older, the kind of study which is required must be correspondingly individual. Only after the collection of a vast amount of information will any reliable summary be possible.

It may be that the "general practitioner," if properly trained, would be in a more favorable position than any other type of physician to secure information useful in tracing the course of slowly developing organic disease. He would be especially well placed to obtain that information if there should be an awakening of both the public and the medical profession to the supreme value of positive, vigorous health. The advantages to be derived from securing health and physiological efficiency instead of being repaired after a breakdown needs to be emphasized. Are not hosts of our people unaware of their defects, as revealed, for example, in our young men when called to military duty? Do many of us realize that minor ills can spoil the keen edge of living? Do we strive to get into good physical condition and stay there? Do we give to our bodies, which are composed of irreplaceable parts, anything like the attention we give our machines with parts replaceable? If the human body is subjected to stress, as it is sure to be when adult responsibilities are assumed, it needs periodic examination to determine whether it is standing up well under the stress. Thus the early stage of a disorder—the stage when treatment is most effective

—can be detected. If only through public education the physician might become the conservator of the family health, keeping the members well so far as possible and being instantly ready to care for them when they fall ill, an enormous benefit would be gained in the well-being of our population. And there would be established a new position for the doctor. He would become a leader in bringing about better modes of living. He would be a teacher of his people in proper diet, proper hygiene and in ways of avoiding conditions which induce disease.

In order that the functions of the physician as a personal or family "health officer" may be reliably performed, standard tests must be devised which will reveal the ability of the body to withstand disturbing influences. Normally our organs maintain a remarkably steady state, a condition of homeostasis, in the circulating blood. No dangerous variations of temperature, blood sugar or alkalinity are permitted. This stability of what has been called our "fluid matrix," in which our living parts reside, is essential for the performance of all our voluntary acts. We now know that as old age approaches, the power of maintaining that stability in the presence of deranging circumstances is gradually reduced.

As a means of obtaining further information regarding human faculties methods of assaying organic efficiency are needed. If medical investigators should invent methods for learning how human experiences affect the fundamental factors which determine homeostasis, a broad territory for medical exploration would be disclosed. The physician, for example, could learn how steady are the steady states and where the critical stress is found, not only in supposedly normal individuals, but also in individuals at various developmental epochs and during disorders. In an illuminating series of tests the abilities of the same individual could be followed in childhood and adolescence, in adulthood and old age, as affected by the demands of school or the exacting periods of puberty and the climacteric, by prolonged labor, fatigue, high altitude, different sorts of training, insomnia, worry and dissipation. Information thus obtained would furnish a measure of physiological age, a measure much more important for many judgments than chronological age. The information would also furnish, in time, a firmer basis for sound advice regarding the right conduct of one's life—the habits to be cultivated and the pitfalls to be avoided.

We now turn to another topic, the use of drugs. There was a period, not so long ago, when, with few exceptions, the possibility of affecting the course of disease by employing chemical agents was too remote to be entertained. While pathological anatomy

dominated medical thought, examination of bodily tissues after death revealed alterations in them which were so extreme that any attempt at their restoration to a natural state by drug treatment was commonly regarded as futile. So great was the lack of trust in medicaments that now that period is looked back upon as an era of "therapeutic nihilism." Advances in medical knowledge have slowly reversed the attitude of despair and have disclosed opportunities of a bright future. Diseases have gradually come to be recognized at earlier stages, when the features which are prominent are altered physiological functions. Then, before the fixed and final structural accompaniments have become established, therapeutic measures can be effective. Furthermore, hope has been revived by illustrious discoveries of specific means of curing illnesses formerly regarded as extremely dangerous or quite incurable. Antitoxin, for example, has banished the terrors of diphtheria; extracts of glands of internal secretion have, with magic potency, rescued the cretinous child from his idiocy and brought both life and vigor to wasting diabetics; preparations of liver have pushed death away from the bedside of patients succumbing to pernicious anemia; nicotinic acid has marvelously restored both the bodies and the minds of victims of pellagra; and within the last few years the miraculous cures wrought by the sulfonamide compounds have opened a door to the future that is of limitless significance.

At a time when pharmacology or pharmacotherapy faces the brightest prospects it is found to be badly neglected. In about a third of the medical schools of the United States there is no independent department devoted to the experimental study of the action of drugs and to their use in treating disease. A discipline which should enjoy a central position among the dynamic medical sciences, sending its roots into organic chemistry, physiology, biochemistry and exploratory pathology, and thrusting its outstretched branches into various hospital clinics, is often merely an incidental interest in a collateral department of the medical school.

As we have previously noted, there are many afflictions which scourge mankind concerning which almost nothing is known. Do not the triumphs already achieved give promise of further conquests? Will not trained intelligence applied to the problems of cure bring further relief to humanity in its suffering? Should not the possibilities of control of the processes of pathology be explored to the uttermost? Here, in the realm of therapy, is another gage thrown down before the investigators of medical mysteries.

A problem which confronts workers in the medical

sciences and which fortunately does not disturb workers in other sciences, except psychology, is that of preserving freedom to carry on research. The amazing advances of modern physics and chemistry and their uses in arts and manufacture have developed from experimentation. Likewise the revolutionary progress in the control of disease that has been achieved during the past ninety years has resulted from practical applications of results obtained by experiments. In order to employ the experimental method, however, the physiologist, pharmacologist or immunologist must put his questions to living organisms and obtain from them his answers, for only they are capable of responding. Because medical investigators perform experiments on lower animals, however, they have been reproached and persecuted and had all manner of evil charged against them falsely. The hostile charges can be analyzed into two main groups—that animal experimentation is conducted with an intolerable infliction of pain, and that all the effort and expense are utterly useless.

It is not generally known that about a third of a century ago faculties of the medical schools of the United States established by formal vote their own humane code for the treatment of animals used in experiments and provided that this code should be posted in all laboratories where animal experimentation is extensively practiced. To any one widely acquainted with medical investigators and the methods which they employ, these regulations, when they were adopted, merely defined the already humane conditions under which experimental medicine was being conducted and stated a program for the continuance of those conditions. To beginners in research and to interested people the regulations indicated the spirit of the investigators and the consideration given by them to the avoidance of unnecessary pain. So assured were the deans of medical schools and the directors of institutes of medical research that animals are treated in the laboratories in a manner above any reasonable reproach that twenty years ago the "open door" policy was adopted. In accord with that policy there was a publicly declared willingness to admit to the laboratories at any time representatives of humane societies in order that they might become acquainted with the actual conditions under which animal experimentation is being carried on. In some instances it was stipulated that the representatives must have previously seen an operation on a human being to enable them to appreciate the similar humaneness of the laboratory methods.

The charge that the results of experiments on lower animals are useless has been amply disproved. Articles by well-known physicians, surgeons and public

health officers—all recognized experts in their several fields—have been prepared and published in the most widely circulated medical journal of the country, showing definitely how animal experimentation has contributed in a direct and decisive and fundamental fashion to practical medicine and surgery.

In spite of overwhelming evidence that animal experimentation is carried on in a humane manner, in spite of practically unanimous expert testimony that animal experimentation has been a prime factor in the beneficent advances of modern medicine, the problem of assuring freedom of research still confronts medical investigators. Persons who do not enter the laboratories in which they declare animals are cruelly tortured, who do not see the operations they criticize, who do not know about different degrees of effective anesthesia, who are unaware of the history of medical progress and of the incomparable benefits to mankind conferred by modern medical discoveries, who are indifferent to the dire problems still presented by diseases which continue to kill their thousands and tens of thousands—these persons, combining real ignorance with unchecked imagination, spread dark suspicions and insinuations about honorable men whose lives are devoted, through research, to the relief of human ills. Furthermore, these misguided humanitarians endeavor, by harrowing and misleading descriptions, to rouse the public to a degree of hostility that will result in either seriously limiting or completely abolishing the most efficacious means of advancing medical knowledge. Leaders in universities and medical schools who, during the past half-century, have fought against the foes of liberty of learning have thus far preserved that liberty—to the inestimable advantage of future generations. The fight will not cease, however, so long as there are groups of our population who would stop animal experimentation even though it releases mankind and lower animals as well from wasting disease, avoidable pain and premature death.

Struggle against the common enemies of man—disease, pain and early death—turns attention to the disastrous cooperation of these enemies with warring hosts when nations battle against nations for supremacy. The terrible devastation now going on in Europe and the fear of more extensive spread of the catastrophe have included medical research in a warping of scientific activities away from untrammeled pursuits towards problems of military significance. In our country what may be the consequences for men engaged in medical investigation? The answer to that question appears to be closely related to what may happen abroad. It seems probable that for years to come the need to repair the wreckage and the appalling waste resultant from the present

titanic strife will leave European nations in such poverty that scientific studies will be sadly slighted. Whether or not the Western Hemisphere becomes involved in the conflict we are likely to find our associations with the Latin American nations south of us more and more intimate. In the past these nations have looked to Europe for medical training. Recently, however, they have begun to turn to the United States for instructive experience and discipline, both in the clinics and in the medical sciences. Circumstances indicate that this trend will continue and, as time passes, will become more prominent. The opportunity thus presented for medical investigators here to exert a stimulating influence in countries where hitherto relatively little investigative activity has been going on may have far-reaching effects. The need for development in these countries should not be criticized. We should remember that our own participation in the advancement of science has been recent. In relation to the medical sciences it may be recalled that the first experimental laboratory in our country that was available for medical research was established only 70 years ago. Before that period, what De Tocqueville wrote in 1850 was still pertinent—"that among civilized people of our age there are few in which the highest sciences have made so little progress as in the United States." We were fairly charged with collecting the treasures of the intellect without taking the trouble to create them. Although not many important centers of medical research have been established in South America De Tocqueville's charge can not properly be transferred to all that continent. The achievements of the laboratory of physiology at Buenos Aires, for example, admirably illustrate the capacity of Latin Americans to become deeply concerned with medical problems and to bring to fruition studies of first-rate importance. To some extent we have opportunity to send our promising young investigators to profit by experience with our Spanish-speaking colleagues. To a larger extent, experts in research in our university medical schools face the happy prospect of performing for enterprising candidates for careers in productive scholarship, who come from countries south, the same sort of stimulating service which European leaders in the medical sciences performed for ambitious American doctors two or three generations ago. No more effective means could be devised for strengthening the bonds of fellowship and understanding between the United States and its southern neighbors.

Finally we may note that a highly important problem which faces medical investigators is that of filling their own ranks. The young men who enter medical schools now-a-days are often well dis-

ciplined in the basic studies and therefore are prepared to enter one or other of the pre-clinical departments to engage in research. Indeed, inquiry shows that not a few medical students participate in an investigation before they receive the doctorate, and some of their published discoveries have proved important. As a rule, however, the youth who starts on the long road to a career in medicine has set as his goal his service as a practitioner. If he is enticed away from that purpose he may be made unhappy in regretting that he did not pursue his original aim. And yet, if the pressing problems of disease are to be solved, they must be solved by the devoted labors of men who single-mindedly apply their talents to such tasks. What are the rewards, the satisfactions, which a medical student may anticipate if he decides to spend his life in striving for further insight into the mysteries of the organism and the perturbations which it suffers?

First of all it is a life of adventure. William Harvey, among the foremost physiological discoverers, expressed, more than three hundred years ago, the spirit of research when he wrote:

It were disgraceful, with this most spacious and admirable realm of nature before us, and where the reward ever exceeds the promise, did we take the reports of others upon trust, and go on coining crude problems out of these, and on them hanging knotty and captious and petty disputations. Nature is herself to be addressed; the paths she shows us are to be boldly trodden; for thus, and whilst we consult our proper senses, from inferior advancing to superior levels, shall we penetrate at length into the heart of her mystery. . . . Truly in such pursuit it is sweet not merely to toil, but even to grow weary, when the pains of discovering are amply compensated by the pleasures of discovery.

Regret has been expressed that here in our country the frontier with all its possibilities of fresh experience has disappeared. That is true in geography but not in science. All that one need do to come into direct contact with border ways and conditions is to step inside an active laboratory where experimental researches are in progress, and there, in the zone separating the known from the unknown, is a frontier which offers all the excitement and thrill of testing projected hazards. Beyond that frontier is a realm of ignorance incomparably more vast than any which the lands and waters of the earth ever enticed a man to explore. Penetration into that illimitable territory is, to be sure, difficult. It is beset by many chances of error, but, as once was true of our western border, it holds forth enticing opportunities for fruitful discoveries and it exacts rigorous qualifications of those who would venture therein.

Initiative and resourcefulness, enterprise and in-

dependence, ingenuity and skill—all are called into action. Because every discovery becomes the basis of further discovery, imaginative insight, to catch the dawning significance of a fresh revelation, is constantly stimulated. New facts suggest in turn other facts and point to unsuspected relations between phenomena which have long been known. Thus, though the investigator's interests may at the moment seem narrow and restricted, they may nevertheless lead his thought outward into unpredictable ranges of knowledge. These excursions of the imagination offer again and again suggestions for fresh adventure. The look, therefore, is always forward to what may be seen when the next step is taken. Seeking new things becomes in time a fixed habit. Past successes neither furnish contentment nor hold attention; they become fused with the established routine of existence from which it is a happiness to escape. The chance of beholding unsuspected wonders, or the demonstration that something imagined is really true, is a continuous incitement to further search, and furnishes the zest and interest which are among the greatest of the rewards.

Sometimes an investigator has the satisfaction of seeing a direct practical outcome of his studies. The question may be raised as to whether, in that respect, research in the medical sciences does not offer a considerable advantage over research in other natural sciences. Too often increased knowledge of natural forces, acquired by scientific studies, has been employed in harmful as well as in beneficial ways. To these balanced consequences, good and evil, the consequences of medical investigations, as previously noted, are in striking contrast. It would be difficult, if not impossible, to find that any one of the many important discoveries made in the medical sciences during the past hundred years has been used by fighting forces for the destruction of life or for doing harm to the enemy. Instead, medical investigators, by learning the nature and cure of malnutrition, by devising appropriate treatment for shock and hemorrhage, by discovering varieties of local and general anesthetic agents and by gaining control of infections, have immensely mitigated the torments and ravages of warfare.

There is another consideration eminently creditable to the efforts of medical investigators. Because life and health are precious and medical research is deeply concerned with protecting life and health, the triumphs of that research are put to use without regard to any national or racial difference. There is no escape from the succor which they bring. Even though the beneficiaries may despise their benefactors, they must receive the benefactions. Is a follower of the Fuehrer bleeding to death and desperately dependant on a blood transfusion? His

life is saved by methods discovered by Landsteiner, once an Austrian. Does a Japanese complain of a bewildering dizziness caused by disturbance of the internal ear? He will be in debt to Bárány, a Hungarian investigator. Does an Italian doctor wish to know whether a patient has typhoid fever? He applies observations first made by Widal, a Frenchman. Is one of our children in danger of diphtheria? His resistance to infection is tested by a process invented by Schick. Goldberger, an immigrant to New York's East Side, provided a simple preventive and treatment of pellagra, which made possible the lifting, from hosts of miserable people, the blight of that dreadful disease. And no matter in what country they may be, the tens of thousands of victims of syphilis must rest their hope of relief on a method of diagnosis first devised by Wassermann, and on a curative method discovered by Ehrlich, both Germans at a time when Germany recognized, without contempt and malignity, the value of ingenious devotion to human welfare. All these contributors to medical knowledge have been citizens of various lands, but they would all be classed as belonging to one people. And though in

the last years their people have been again savagely and sadistically persecuted, no nations, however hostile, can take from these medical representatives the honor and glory of having served as saviors of their fellow men.

The attractions and the rewards of medical investigators have been described in some detail because the problem of filling the ranks of those who engage in medical research is of primary importance. Unless the ranks can be kept unbroken, unless well-equipped recruits can be attracted to the career of the investigator, progress ends. The opportunities for long-enduring service to humanity should be widely known. Gifted young men should be aware of the chances which are opened to them and should prepare themselves accordingly. Universities should remove any financial obstacles which may confront the productive scholar looking forward to decades of medical investigation. The conquest of a disease, it should be remembered, is a permanent conquest. Humanity will be protected thereby through indefinite future time. An immortality of blessed memory awaits those who bring to mankind further respite from debility and pain.

## THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE SPECIAL RESEARCH CONFERENCES ON CHEMISTRY

By Dr. F. R. MOULTON  
PERMANENT SECRETARY

In each of the past four summers special research conferences on chemistry have been held at Gibson Island, Md., under the direction of Dr. Neil E. Gordon, secretary of the Section on Chemistry of the American Association for the Advancement of Science. With the recent purchase of a property by the association for the use of the conferences they are now put on a permanent basis.

The Gibson Island conferences are unusual if not unique in character. Each conference, devoted to a single well-defined subject, occupies a period of five days from Monday to Friday, inclusive, during which ten sessions are normally held. The first session begins at 10 o'clock on Monday morning and consists of only one or two formal papers. The remainder of the time until adjournment for lunch at 12:30 is available for discussions. Usually no program is scheduled for the afternoon, but discussions by small groups often continue. A second program of one or two papers is held in the evening, followed by discussions often continuing until a very late hour.

Similar schedules are followed during the remainder of the week.

The Gibson Island special conferences on chemistry owe their excellence and popularity to careful planning of the programs by experts, the choice of the invited contributors, the freedom with which contributors make excursions along, and sometimes beyond, the frontiers of the known, the opportunities for abundant discussion, the limitation of participants to sixty, the mingling of chemists from industrial and university laboratories and the delightful surroundings. At its business meeting each conference determines the subject of the corresponding conference for the following year and nominates its chairman and vice-chairman, who are formally appointed by the association.

The subjects of the conferences so far held and the names of their chairmen are as follows:

1938

A. Relation of Structure to Physiological Action.  
Harold C. Urey, *chairman*.

B. Cellular Metabolism and Tissue Respiration. C. G. King, *chairman*.

1939

A. Resinous Polymers. H. L. Bender, *chairman*.

B. Vitamins. C. G. King, *chairman*.

C. Relation of Structure to Physiological Action. Walter H. Hartung, *chairman*.

1940

A. Frontiers in Petroleum Chemistry. C. R. Wagner, *chairman*.

B. Catalysis. E. C. Williams, *chairman*.

C. Organic High Molecular Weight Type Compounds. H. L. Bender, *chairman*.

D. Vitamins. C. G. King, *chairman*.

E. Relation of Structure to Physiological Action. Walter H. Hartung, *chairman*.

F. Applications of X-ray and Electron Diffraction. Maurice L. Huggins, *chairman*.

1941

A. Frontiers in Petroleum Chemistry. C. R. Wagner, *chairman*.

B. Catalysis. E. C. Williams, *chairman*.

C. Organic High Molecular Weight Compounds. S. S. Kistler, *chairman*.

D. The Structure and Chemistry of Textile Fibers. Milton Harris, *chairman*.

E. Vitamins. C. G. King, *chairman*.

F. X-ray and Electron Diffraction. Maurice L. Huggins, *chairman*.

G. Corrosion. R. M. Burns, *chairman*.

H. Photosynthesis. O. L. Inman, *chairman*.

It is expected that ten conferences will be held in 1942, probably beginning on June 22.

Gibson Island is situated in Chesapeake Bay about 20 miles south of Baltimore. It is approximately 1,000 acres in area and is connected with the mainland by a causeway. The island is privately controlled and admission to it is only by card from the Gibson Island Club. In addition to the club and the property purchased by the association, there are about 80 private residences on the island, leaving most of it quite uninhabited and covered by forests. The island offers opportunity for golf, tennis, both salt and fresh water bathing, fishing and sailing.

The property purchased by the association consists of a large residence and auxiliary buildings on a wooded lot 3.6 acres in area situated on the highest hill on the island. The conferences are held on a large

screened porch that can be darkened enough to permit of the use of projection equipment in the day time. The house provides accommodations for about 25 men. Others attending the conferences, including those who are accompanied by their wives, live at the club. All meals are taken at the club.

Substantial gifts by industrial companies whose laboratories have been represented at the Gibson Island conferences have enabled the association to purchase the property. Each contributing company has the right to have a representative at each conference. This is a substantial right because there have been many more applicants for admission to the conferences than can be accepted unless the limit of 60 that has been set is exceeded. It has been felt by the participants that to make the conferences larger would take from them something of the informality and intimate contacts that have made them valuable. The companies that have so far contributed to the project are as follows:

Atlantic Coast Fisheries Company, New York City.

The Barrett Company, New York City.

Davison Chemical Corporation, Baltimore, Md.

Distillation Products, Inc., Rochester, N. Y.

Ethyl Gasoline Corporation, New York City.

General Electric Company, Schenectady, N. Y.

B. F. Goodrich Company, Akron, Ohio.

Hercules Powder Company, Inc., Wilmington, Del.

Merck and Company, Inc., Rahway, N. J.

Monsanto Chemical Company, St. Louis, Mo.

Norton Company, Worcester, Mass.

Pittsburgh Plate Glass Company, Barberton, Ohio.

Standard Brands, Inc., New York City.

Standard Oil Development Company, Elizabeth, N. J.

The Texas Company, New York City.

Since the conferences have now been provided a permanent home it has been suggested that the whole project be known as the *A. A. A. S. Research Institute*. In order that it may be guided with the maximum wisdom a Policy Committee has been set up, consisting of the director of the conferences, the chairman and vice-chairman of each conference, representing the association, and a representative appointed by each of the contributing companies. The first meeting of the Policy Committee will be held on September 9 at Atlantic City at the time of the meeting of the American Chemical Society.

## THE SOUTHWESTERN DIVISION

By Dr. FRANK E. E. GERMANN

EXECUTIVE SECRETARY

THE twenty-first annual meeting of the Southwestern Division of the American Association for the Advancement of Science was held in conjunction with

nine associated societies at Lubbock, Texas, during the week of April 28, 1941. The associated societies were the Council of Texas Archaeologists, the Clearing

House for the Southwestern Museums, the Mathematical Association of America (Southwestern Section), the Society for American Archaeology, the Texas Archaeological and Paleontological Society, the West Texas Chamber of Commerce Resource and Museum Institute, the West Texas Division of the Texas Academy of Science, the West Texas Historical and Scientific Society and the West Texas Museum Association.

Through the splendid efforts of the local committee, headed by Dr. William M. Craig, the faculty and students of the Texas Technological College contributed very greatly to the success of the meeting, both from the point of view of the presentation of papers and of attendance at the sessions. In addition to the one hundred and fifteen regularly registered scientists, a large number of students were enrolled without charge and given student badges. As a result of this encouragement, the attendance of students at the various sessions was large. Attendance at each of the four sections which met simultaneously ranged from fifty to one hundred. A total of one hundred and forty papers were presented.

A committee for the entertainment of visiting ladies, headed by Mrs. Roscoe Wilson, provided diversion for those not caring to attend the scientific sessions. The entire association participated in a tea given by President and Mrs. Clifford B. Jones on Monday from four-thirty to six at their beautiful home on the campus.

The field trips planned for Thursday included an all-day trip to the Canadian River archeological sites north of Amarillo, a study of native vegetation in the nearby canyons, an all-day trip to the Calgary Triassic deposits and vertebrate remains, a study of dry and irrigated windbreaks and plantings of introduced trees and shrubs. Because of very heavy rains, most of these trips did not materialize.

On Sunday evening the executive council held a business session at the home of Dr. W. M. Craig, at which time it was decided to meet jointly with the American Association for the Advancement of Science in Dallas, December 29, 1941, to January 3, 1942, as well as to urge our members to participate in the sessions of the Pacific Division meeting in Salt Lake City in June, 1942.

The secretary was asked to attend the Dallas meeting as the official delegate of the division and to circularize the members regarding the desirability of their individual participation. In order to harmonize the name with past practice, it was voted to change the title of the secretary-treasurer to executive secretary-treasurer. Dates of future meetings were discussed, and it was agreed that the 1942 meeting would be in Las Cruces, New Mexico.

In recognition of his outstanding work in the field of geology, geography and archeology, Dr. Robert Thomas Hill, of Dallas, Texas, was elected an honorary member of the Southwestern Division. Dr. Hill died on July 28 in his eighty-third year.

In view of the proximity of Las Cruces, the place of the 1942 meeting, to Mexico, an increased effort is to be made this year to interest the scientists of Mexico in the meetings of the Southwestern Division. Many European scientists are now refugees below the border, and it is hoped to bring about a closer bond for our mutual benefit. This action is especially fitting since the states of Chihuahua and Sonora lie within the boundaries of our division.

At the first general sessions on Monday morning President Clifford B. Jones gave the welcoming address, to which Dr. C. V. Newsom, chairman of the department of mathematics of the University of New Mexico and president of the division, gave the response. On Monday evening, following the annual Sigma Xi dinner, Dr. Ernst Antevs, research associate of the Carnegie Institution of Washington, gave an illustrated address on "Climatic Variations in the Southwest During the Past 75,000 Years." On Tuesday Dr. E. T. Bell, professor of mathematics at the California Institute of Technology, gave a very interesting popular lecture to a combined group of scientists on the subject of "Diophantine Analysis."

For the past twelve years the Southwestern Division has sponsored a general public lecture named in honor of General John Wesley Powell, the first explorer of the Grand Canyon of the Colorado River. This year the speaker was Dr. Bernadotte Everly Schmitt, who spoke on Tuesday evening to a large enthusiastic audience in the Senior High School Auditorium on the subject, "The United States and the War." Dr. Schmitt is Andrew MacLeish distinguished service professor at the University of Chicago and Pulitzer prize winner for his work, "The Coming of the War, 1914." The annual dinner of the division was held in the ball room of the Hilton Hotel on Wednesday and was followed immediately by the address of the retiring president, Dr. C. V. Newsom, who gave a talk on "Mathematics and the Sciences." Another address thrown open to the public was that of Dr. F. S. Hienika, regional game manager of the Game, Fish, and Oyster Commission, who spoke on "Conservation of Wild Life."

Officers elected at the general business session and the business sessions of the various sections are as follows:

*President:* Dr. William M. Craig, professor of chemistry, Texas Technological College, Lubbock.

*Vice-President:* Dr. H. P. Mora, Laboratory of Anthropology, Santa Fe, New Mexico.

*Executive Committee:* Dr. C. V. Newsom, University of

New Mexico, Albuquerque, for a three-year term; and Professor Victor J. Smith, Sul Ross State Teachers College, Alpine, Texas, to serve the remaining unexpired term of Dr. H. P. Mera, who was elected vice-president.

*Biological Sciences:*

*Chairman*, Dr. A. L. Hershey, Las Cruces, New Mexico  
*Secretary*, Dr. Omer E. Sperry, Alpine, Texas

*Mathematics:*

*Chairman*, Professor Roy MacKay, Portales, New Mexico  
*Vice-Chairman*, Dr. Lyle Mehlenbacher, Flagstaff, Arizona

*Secretary*, Dr. Harold D. Larsen, Albuquerque, New Mexico

*Physical Sciences:*

*Chairman*, Dr. C. T. Elvey, Fort Davis, Texas  
*Secretary*, Dr. Oscar B. Muench, Las Vegas, New Mexico.

*Social Sciences:*

*Chairman*, Professor F. Martin Brown, Colorado Springs, Colorado  
*Secretary*, Miss Katharine Bartlett, Flagstaff, Arizona

## SCIENTIFIC EVENTS

### CHEMICAL RESEARCH REPORTS

THE United States has led the world in the output of chemical research reports for the past ten years according to a survey made by Dr. E. J. Crane, professor of chemistry at the Ohio State University

"Curves showing the relative shares of Germany and the United States in percentages of the world's total output of chemical papers since 1913 would take the form of an 'X' lying on its side with the upward slant representing the United States and the downward slant, Germany." Dr. Crane states that:

The crossing of the lines apparently occurred in 1930. An irregular spot would indicate the effects of the world war. An almost straight curve underlining this prostrate 'X' would represent the output of the next most active country--the British Empire.

In 1913, the last year before the world war, the German output of chemical papers was 34.4 per cent. of the world's total, while that of the United States was 20.7 per cent. and of the British Empire, 14.4. In 1939, in a sense the last year before the beginning of the present war in Europe since it got under way slowly and publication was little affected at first, the output of papers in the United States had reached 27.7 per cent. and Germany's had dropped to 18.7, with the British output remaining approximately 14 per cent.

At approximately the time when the lines of the 'X' cross, the British output was 13.5 per cent.; figures showing the effects of the world war (14.9, 16.8 and 15.4 per cent. for the British Empire for 1917, 1918 and 1923) still justify keeping the British curve approximately straight.

Most noteworthy is the strong development of chemical publication in Russia, which in 1913 has 2.5 per cent. of the total number of abstracts; in 1929, 3.4 per cent. and in 1939, 11.1 per cent. A good many Russian chemists have also been publishing papers in German periodicals.

While the figures on abstracts are not an exact measure of chemical research activity in the various countries, they have a good deal of meaning, nevertheless. No doubt there has been a growing amount of chemical research work directly bearing on national defense which

has not been published. This may be true to a larger degree for some countries than for others.

There is also much industrial research activity that is not reflected in the publication of papers. Perhaps the number of chemical patents issued in the various countries may be considered a rough measure of industrial research activity in chemistry. In 1939, *Chemical Abstracts*, which endeavors to cover the chemical patents completely, published the following numbers of patent abstracts: United States, 7,727; Great Britain, 4,872; Germany, 2,929; France, 2,377.

The chemists of a few of the smaller countries, as Denmark, publish a considerable percentage of their papers in the journals of other countries. Happenings in Europe during the past year make the listing of countries puzzling, but the present survey ends with 1939.

France was fifth in number of abstracts published in 1939, ranking after the Soviet Union. Her percentage of the total was 9.1; Japan came next with 4.4 per cent., and Italy seventh, with 3 per cent. In 1913, Italy's percentage was 4.7, and in 1929, 3. France's percentage in 1913 was 13; it dropped to 7 in 1929. Japan had a percentage of only 0.37 in 1913, but reached 3.7 by 1929.

### GRANTS OF THE GEOLOGICAL SOCIETY OF AMERICA

IN addition to grants authorized by the council of the Geological Society of America, which have already been reported, the following grants have been made in paleontology and petrology:

*Paleontology, Invertebrate*—\$1,700.

Charles A. Anderson, University of California, will be assisted by J. Wyatt Durham in the study of Pliocene fossils collected in 1940 in Lower California on the cruise of the *E. W. Scripps* into the Gulf of California under a grant from the Geological Society of America. Mr. Durham was an assistant on that expedition and collected the fossils. \$950.

E. R. Eller, Carnegie Museum, will study the Manitoulin (Silurian) dolomite of New York and Ontario with view to correlating its beds with beds of equivalent age in other parts of North America. Special study is to be

made of scolecodonts in the hope of proving their uses as index fossils. \$300.

J. Harlan Johnson, Colorado School of Mines, will study Pennsylvanian and Lower Permian algal limestones from Kansas. He already has studied algal limestones from Colorado and New Mexico and will now demonstrate the importance of algal limestone deposition in Kansas during the late Paleozoic. \$300.

Vladimir J. Okulitch, University of Toronto, will return to the United States National Museum in Washington for four weeks to complete his study of North American Pleospongia. \$150.

*Paleontology, Vertebrate*—\$2,197.40.

Barnum Brown, the American Museum of Natural History, and E. M. Schlaikjer, Brooklyn College, will complete their revision of the Ankylosauria. \$750.

Miss Tilly Edinger, Harvard University, is to study the evolution of the brain in the horse evolutionary series by investigation of endocranial casts. \$217.40.

Alfred S. Romer, Harvard University, receives additional aid to complete his preparation of a bibliography of vertebrate paleontology of countries exclusive of North America up to 1933, which has been in process under a previous grant. \$900.

Horace Elmer Wood, 2nd, University of Newark, will devote the summer to stratigraphic work in Wyoming in continuing his correlation of the North American continental Tertiary. \$330.

*Petrology*—\$3,340.

V. T. Allen, St. Louis University, will collect clays from selected localities extending from Georgia to New Jersey and will study them by petrofabric, x-ray and chemical methods with special reference to the formation of diaspore, bauxite and "hydro-mica" by processes of weathering. \$450.

Ernst Cloos, the Johns Hopkins University, will intensify his quantitative investigation of rock flowage in relation to cleavage and folding by means of statistical measurements of deformed oolites in Paleozoic limestones of one of the outstanding uplifts in the Appalachians, the South Mountain uplift of Maryland and Pennsylvania. \$995.

John C. Haff, Colorado School of Mines, will study ocellar structure in lamprophyric dikes and alkaline extrusives. Petrofabric analyses will be made of grain orientation around vesicles and phenocrysts in an investigation of the mechanism of formation of ocelli and their part in the consolidation history of the rocks examined. \$70.

E. B. Mathews, the Johns Hopkins University, will complete his compilation and classification by geographical position of all available analyses of igneous rocks published prior to 1940, some 85,000 items. \$700.

Aaron C. Waters, Stanford University, will complete a petrologic and stratigraphic investigation of the Columbia River basalt in eastern Washington and adjacent parts of Oregon and Idaho. \$1,125.

## THE OPTICAL SOCIETY OF AMERICA

THE twenty-sixth annual meeting of the Optical Society of America will be held in New York City

with headquarters at the Hotel Pennsylvania, on October 24 and 25.

Symposia of invited papers have always been important features of the meetings of the society. This year a symposium on the role of "Optics in the National Defense" is being arranged for the session on Friday morning, October 24. Due to uncertainties arising from the national emergency, it has seemed best to defer announcement of the speakers and their titles until the program of the meeting is mailed to the members early in October. The annual dinner of the society will be held on Friday evening. A special feature of this dinner will be the award of the Frederic Ives Medal. The sessions on Friday afternoon and on Saturday will be devoted to the presentation of contributed papers.

The time and place of this annual meeting, according to the preliminary announcement, were selected by the Board of Directors with an appreciation of the fact that many members of the society have additional duties because of the emergency which make attendance at meetings less convenient than in normal times. Through cooperation with other societies to which many of our members belong, there will be meetings of four national societies at the Hotel Pennsylvania during the week of October 20. The Society of Motion Picture Engineers will hold its meeting from October 21 to 23 inclusive. The Acoustical Society of America and the Society of Rheology will hold their meetings on October 24 and 25, simultaneously with that of the Optical Society. A joint luncheon is being arranged for Friday, October 24; and plans for other features of common interest are being formulated. It is hoped that the membership will demonstrate its appreciation of this consolidation of activities by making reservations immediately at the Hotel Pennsylvania.

Members desiring to communicate papers to the meeting should send abstracts to the secretary on the usual form. All abstracts must be in the hands of the secretary not later than noon of September 22. The appropriate grouping of contributed papers will be greatly facilitated if members intending to present papers will forward their abstracts to the secretary at the earliest possible date.

The meeting will be open to non-members as well as to members. All those interested are cordially invited to attend. Non-members who desire to receive the advance program, final notices or other information in regard to the meeting should address their requests to the secretary, Arthur C. Hardy, Massachusetts Institute of Technology, Cambridge, Mass. The chairman of the program committee is A. W. Kenney, E. I. du Pont de Nemours and Company, Wilmington, Del.

## RECENT DEATHS

DR. BANCROFT GHERARDI, vice-president and chief engineer of the American Telephone and Telegraph Company, retired, and formerly president of the American Institute of Electrical Engineers, died on August 14. He was sixty-eight years old.

DR. LUDWIG KAST, president of the Josiah Macy Jr. Foundation, previously professor of medicine and trustee of the New York Post-Graduate Medical School and consulting physician, died on August 13 at the age of sixty-four years.

GEORGE AUGUSTUS FICHT, for the past fourteen years in charge of European corn borer investigations of the Agricultural Experiment Station of Purdue University, with headquarters at Auburn, Indiana, died on July 29 at the age of forty years.

SIR ARTHUR EVANS, formerly professor of prehistoric archeology at the University of Oxford, died on

July 11. He had celebrated his ninetieth birthday on July 8.

DR. PAUL SABATIER, professor of chemistry at the University of Toulouse since 1882, died on August 15 at the age of eighty-seven years.

A CORRESPONDENT writes: "Professor Martin Jacoby died on July 25, in Manchester, England, in his seventieth year. He was professor extraordinarius in pharmacology at the University of Heidelberg until 1906 and thereafter, almost until his emigration from Germany in 1939, director of the laboratories at one of the large municipal hospitals in Berlin, the Krankenhaus Moabit. His working field was immunology, pharmacology and biochemistry, especially enzymology. Most of his publications appeared in the *Biochemische Zeitschrift*. Since his resignation from the Berlin hospital, he lived first in Berlin and then in his sixty-ninth year emigrated to England."

## SCIENTIFIC NOTES AND NEWS

DR. OSCAR RIDDLE, of the department of genetics of the Carnegie Institution of Washington at Cold Spring Harbor, N. Y., has been elected a foreign corresponding member of the Academia Nacional de Medicina, Argentina.

DR. GEORGE D. BEAL, assistant director of the Mellon Institute, has been awarded the Remington Medal for 1941 of the American Pharmaceutical Association. The award was made "for distinguished service to the profession of pharmacy and for fundamental research in the pharmaceutical field."

THE American Chemical Society Prize of \$1,000 in pure chemistry has been awarded for 1941 to Dr. Karl A. Folkers, assistant director of research in the Merck Laboratories, Rahway, N. J. Presentation of the award, given annually "for outstanding research in pure chemistry by a man or woman less than thirty-six years old," will take place at the one hundred and second meeting of the society, which will be held from September 8 to 12 in Atlantic City. During the past five years Dr. Folkers has successfully isolated and determined the character of many new erythrina alkaloids.

MISS D. F. BLEEK, of Cape Town, in recognition of her researches on the Bushmen, has been awarded the South African Medal and grant for the year 1940-41 of the South African Association for the Advancement of Science.

ACCORDING to the *Journal* of the Canadian Dental Association, Dr. R. Gordon Agnew, professor of dental pathology at the West China University, Chengtu, received at the June commencement the

degree of Ph.D. in dentistry from the University of Toronto.

AMONG the honorary degrees conferred on July 10 by the University of Aberdeen was the doctorate of laws on Professor J. C. Philip, emeritus professor of physical chemistry in the Imperial College of Science and Technology, London, president of the Chemical Society.

SIR ALFRED WEBB-JOHNSON, professor of surgery and pathology of the Royal College of Surgeons, London, has been elected president of the college for the coming year. Surgeon Rear-Admiral G. Gordon-Taylor and L. R. Braithwaite have been elected vice-presidents.

THE following officers of the British Institution of Electrical Engineers have been elected for 1941-42: *President*, Sir Noel Ashbridge; *Vice-president*, Professor S. Parker Smith; *Honorary Treasurer*, E. Leete.

DR. BENJAMIN F. KINGSBURY, professor of histology and embryology at Cornell University, has retired with the title emeritus; Dr. Karl M. Wiegand, professor of botany and head of the department in the College of Agriculture, retired at the close of the summer session also with the title emeritus. He will be succeeded by Dr. Lewis Knudson, professor of plant physiology.

DR. OTTO GLASER, Stone professor of biology on the E. S. Harkness Foundation at Amherst College, has been appointed acting president of the college during the absence of the president.

DR. HELMUTH LANDSBERG, of the Pennsylvania

State College, has been appointed associate professor in the Institute of Meteorology of the University of Chicago.

DR. COLIN M. MACLEOD, associate of the Rockefeller Institute for Medical Research, has become professor of bacteriology in the New York University College of Medicine and director of the bacteriological laboratories. Assistant Dean John H. Mulholland has been appointed professor of clinical surgery, and Dr. Frank C. Combes has been promoted to a professorship of dermatology and syphilology.

DR. HENRY F. VAUGHAN, formerly health commissioner of Detroit, has been made dean of the new School of Public Health of the University of Michigan. Dr. Vaughan, who has served since early spring as professor of public health, was also made chairman of the department of public health practice. Continuing the transfer of public health work from the old Division of Hygiene and Public Health, Dr. Thomas Francis, Jr., has been made professor of epidemiology and chairman of the department, and Dr. Lowell J. Coggeshall has been made professor of epidemiology. Among others whose appointments are either in whole or in part transferred to the faculty of the new school are Dr. John Sundwall, professor of hygiene and public health, and Dr. Nathan Sinai, professor of public health.

DR. R. M. MELAMPY, who has been associated with the Federal Southern States Bee Laboratory, has become assistant professor in the department of zoology of the Louisiana State University. He will give primarily courses in insect physiology.

DR. ALBERT R. MANN, vice-president of the General Education Board, formerly dean of the College of Agriculture and provost of Cornell University, has been reappointed a member of the New York State Flood Control Commission.

DR. DAVID M. GREENBERG has been promoted from an associate professorship of biochemistry in the Medical School of the University of California to a full professorship. Dr. Eric Ogden has been promoted to an associate professorship of physiology.

DR. EDWIN H. PLACE, a member of the staff of the division of industrial hygiene of the National Institute of Health at Bethesda, Md., has been appointed director of the division of industrial hygiene of the Alabama State Department of Health.

ROBERT M. SALTER, director of the North Carolina Experiment Station, has been appointed head of the Division of Soil and Fertilizer Investigations in the Bureau of Plant Industry, effective in October. This division comprises the former Divisions of Soil Chem-

istry and Physics, Fertilizer Research and Soil Microbiology. He will direct research in soil microbiology, legume inoculants, fertilizer manufacture and use.

GOSTA AKERLOF, associate professor of physical chemistry at Yale University, formerly of the University of Stockholm, has resigned to engage in research with the Thomas and Hochwalt Laboratories, a division of the Monsanto Chemical Company at Dayton, Ohio. John Butler, of the Bakelite Corporation, at Bloomfield, N. J., has also become a member of the staff at Dayton as research chemist.

DR. HANS JENSEN, formerly associate in laboratory endocrine research of the Medical School of the Johns Hopkins University, who has been associated with the Squibb Institute for Medical Research, has joined the staff of the Upjohn Company Research Laboratories, Kalamazoo, Mich.

HERMANN C. FROELICH has resigned his position with the Harshaw Chemical Company, Cleveland, to join the research staff of the Lamp Development Laboratory of the General Electric Company, at Nela Park, Cleveland.

THE annual meeting of the American Electrochemical Society will be held at Chicago from October 1 to 4 under the presidency of Raymond R. Ridgway, of the Norton Company, Chippawa, Ontario, Canada. An extensive industrial exhibit, educational in character, will be an integral part of the meeting. In the same convention hall, the universities in the Chicago area will display material representative of their contribution to science and industry. All exhibits will be constantly supervised by representatives of the industries and schools who are cooperating.

THE American College of Dentists will hold a convocation at the Rice Hotel in Houston, Texas, on October 26.

A UNITED PRESS dispatch states that according to the will of Miss Martha A. Jamison, who died on July 16, religious, charitable and educational institutions will benefit from the income from an estate estimated at \$20,000,000, which will form the Arbuckle Jamison Foundation. Miss Jamison was a niece of Charles and John Arbuckle, coffee and sugar merchants. She and her sister, Miss Margaret Jamison, inherited the bulk of the Arbuckle fortune. On the death of her sister the money will go to the foundation.

THE program of the Conference on the Training of Biologists, to be held between September 18 and 20, as part of the fiftieth anniversary celebration of The University of Chicago, is as follows: *First Session*: Introduction—Presentation of educational programs in biology currently in operation in some

major universities. *Second Session:* Contribution to the training of biologists from the physical sciences and other related disciplines. *Third Session:* The basic educational needs of the biologist. *Fourth and Fifth Sessions:* The specific preparation of biologists for professional specialization (research, teaching, medicine, etc.). The following speakers will take part in the Round Table discussion (Dr. Paul Weiss, University of Chicago, chairman): *From the University of Chicago:* Emmet B. Bay, John M. Beal, William Bloom, Anton J. Carlson, Merle Coulter, Earl A. Evans, Jr., Ralph W. Gerard, Victor Johnson, Wilton M. Krogman, George K. K. Link, Carl R. Moore, William H. Taliaferro and Ralph W. Tyler. *From Other Institutions:* Detlev W. Bronk, University of Pennsylvania; Karl S. Lashley, Harvard University; Dwight E. Minnich, University of Minnesota; Karl P. Schmidt, Field Museum of Natural History; Francis O. Schmitt, Massachusetts Institute of Technology; Edmund W. Sinnott, Yale University; Lawrence H. Snyder, Ohio State University; C. V. Taylor, Stanford University, and Benjamin H. Willner, Johns Hopkins University. For further information and reservations, write to the Director of the Fiftieth

Anniversary Celebration, The University of Chicago, Chicago, Illinois.

GOVERNOR M. M. NEELY, of West Virginia, dedicated on August 2 the new fluorescent lamp works at Fairmont, W. Va., of the Westinghouse Electric Manufacturing Company, in ceremonies which marked the start of manufacturing operations. The building, erected at a cost of \$3,000,000, is a one-story structure, 884 feet long and 240 feet wide. It has no windows. Heat and humidity of the air are regulated by an air-conditioning system which has its source of coolness in subterranean waters of a sealed, abandoned coal mine situated on the 90-acre property. The air is kept free of dust by a precipitron, a Westinghouse device which cleans air by electricity. Fluorescent lights bring artificial daylight into every part of the building. At a dinner in the evening a lecture and demonstration entitled "Horizons of To-morrow" was given by Samuel G. Hibben, of Bloomfield, director of applied lighting for the Westinghouse Company. He illustrated the research work carried out in the laboratory in the various fields of lighting. On a near-by site there is being constructed a glass factory at a cost of \$1,800,000.

## DISCUSSION

### NUTRITIONAL DEFICIENCY AS A FACTOR IN THE ABNORMAL BEHAVIOR OF EXPERIMENTAL ANIMALS

THE albino rat has been observed to exhibit a behavior pattern characterized by epileptoid seizures when subjected to auditory stimulation.<sup>1</sup> Different authors have associated such seizures with a variety of etiological factors,<sup>2</sup> but there can be no doubt concerning (a) the important role that nutrition plays in the manifestation of this type of behavior, or (b) the effect of auditory stimulation alone as an inciting cause of the seizures.

Recent studies in the laboratory for experimental psychology at the University of Pittsburgh have demonstrated clearly that vitamin B-complex deficiencies and inanition both induce sensitivity to the epileptoid seizures. Specific members of the vitamin B-complex, particularly thiamin (B<sub>1</sub>), can effect significant protection at intake levels above those required for growth and reproduction. Paired feeding experiments have been used to avoid possible errors caused by inanition, and although the latter is clearly an important factor in the susceptibility to seizures, pure

vitamin supplements and empirical concentrates such as provided by yeast exert an effect in addition to that afforded by pure thiamin.

A comprehensive program of investigation in this field is under way, supported by research grants from the Buhl Foundation of Pittsburgh and from the Williams-Waterman Fund of the Research Corporation of New York. It is evident that the results of such experiments are applicable to the detection and quantitative evaluation of certain nutritional deficiencies of marginal type, where there is physiological injury without external evidence of malnutrition. It is believed that such investigations also point unmistakably toward the need for an increasing degree of attention to the nutritional state of experimental animals that are used in psychological studies. No record of a comparable type of behavior pattern in clinical observations under controlled conditions has come to the attention of the authors, but neurological manifestations of marginal type vitamin B-complex deficiencies have been observed frequently.<sup>3,4</sup>

C. G. KING  
H. W. KARN  
R. A. PATTON

UNIVERSITY OF PITTSBURGH

<sup>1</sup> Robert A. Patton and Harry W. Karn, *Jour. Comp. Psych.*, 31: 43, 1941; Robert A. Patton, *Jour. Comp. Psych.*, 31: 215, 1941; Robert A. Patton, Harry W. Karn and C. G. King, *Jour. Comp. Psych.* (in press).

<sup>2</sup> N. R. F. Maier, "Studies of Abnormal Behavior in the Rat," Harper, New York.

<sup>3</sup> R. R. Williams and T. D. Spies, "Vitamin B<sub>1</sub> (Thiamin) and Its Use in Medicine," Macmillan, 1938.

<sup>4</sup> R. D. Williams, H. L. Mason, R. M. Wilder and B. F. Smith, *Arch. Int. Med.*, 66: 785, 1940.

# A PHYSIOLOGICAL BASIS FOR THE DIFFERENTIAL RESISTANCE OF THE TWO RACES OF RED SCALE TO HCN<sup>1</sup>

THERE has been considerable interest in the two physiological races of red scale, *Aonidiella aurantii* (Mask.), since their discovery by Quayle.<sup>2</sup> This particular study has to do with the physiological basis of the resistance or non-resistance to HCN fumigation. Two pure strains were very kindly furnished by Dr. D. L. Lindgren<sup>3</sup> of Riverside. The last instar females were carefully removed from the host, either squash or grapefruit, prior to fertilization and placed in a closed chamber under the microscope and the spiracles carefully observed while several dilutions of HCN were admitted to the chamber. In all, 46 females of the resistant race and 17 females of the non-resistant race have been studied. There is no observable difference in the structure of the spiracles of the two races. There are two apparent positions of the inner structure of the spiracles. Testing with oil has shown that in one position the spiracle is closed and in the other it is open. The opening and closing are concurrent with a pulsation of the tracheal trunk. In the normal insect the tracheal trunk pulsates from the open to a partly closed position about 60 times a minute. On admitting HCN to the chamber the behavior of the spiracles of the two races is markedly different. In each race the spiracles close within three to five minutes after the cyanide reaches them. In the resistant race the spiracles remain closed as long as HCN is present for at least 30 minutes. In the non-resistant race the spiracles remain closed for only about one minute and then open and death follows in a short time if the cyanide concentration is lethal. The resistant scale can survive a lethal concentration of cyanide for at least 30 minutes. The closure of the spiracle was tested in each doubtful case by placing a drop of oil upon the insect. The oil penetrated readily if the spiracles were in the open position but did not penetrate when they were in the closed position. The five resistant individuals which failed to maintain closure of the spiracles during fumigation were known to have been injured during removal from the host. There seems no doubt but that the relative ability to maintain closure of the spiracles is sufficient to explain the difference in resistance to HCN of the two races. This study and others now in progress to determine the possible existence of a difference in the cyanide insensitive respiration and also the effect of other substances on spiracular closure will be reported in full

<sup>1</sup> Division of Entomology and Parasitology, University of California, Berkeley, California.

<sup>2</sup> H. J. Quayle, *Jour. Econ. Ent.*, 15: 400-404, 1922.

<sup>3</sup> D. L. Lindgren, *Hilgardia*, 11: 5, 213-225, 1938.

elsewhere. A material which would cause failure of closure would be of the utmost practical importance.

N. F. HARMAN

RODERICK CRAIG

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## PALM PATTERNS AND HANDEDNESS<sup>1</sup>

INVESTIGATION of the handedness and palmar dermatoglyphics of the members of twenty-six families reveals an association within families between pattern D in the fourth interdigital area and functional handedness. Within fifteen of these families variations occur in respect to both traits. The following combinations of the two traits appear within the 348 paired sibs.

Concordant in handedness and pattern D	145 pairs
Concordant in handedness, discordant in D	64 pairs
Discordant in handedness, concordant in D	68 pairs
Discordant in handedness and D	71 pairs

Analysis of these data in a  $2 \times 2$  table gives a Chi square value of 14.8, a highly significant figure. Thus sibs are much more likely to be alike or unlike in respect to both traits than they are to be alike in one and unlike in the other.

In the general population pattern D occurs with equal frequency in both right and left handers. In the twenty-six families studied, no significant relationship exists between handedness and sex or pattern D and sex. These findings would seem to eliminate pleiotropy and sex-linkage as the agencies responsible for the association. Autosomal linkage between factors responsible for handedness and the formation of pattern D appears to be the most likely cause of the association. The investigation will be continued with a large number of additional families.

DAVID C. RIFE

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## THE EARLY USE OF IMPLANTED ELECTRODES FOR STIMULATION OF THE CORTEX CEREBRI

AFTER we had made more than one report on the results of cortical stimulation with implanted electrodes<sup>1</sup> with a method that was evolved from those of Loucks,<sup>2</sup> and Chaffee and Light,<sup>3</sup> and Mussen,<sup>4</sup> there came to my attention the "Method of Ewald"<sup>5</sup> as used

<sup>1</sup> This investigation was made possible by a grant from the National Research Council.

<sup>2</sup> J. W. Ward and S. L. Clark, *Arch. Neur. and Psychiat.*, 38: 927, 1937.

<sup>3</sup> E. B. Loucks, *Jour. Comp. Psychol.*, 16: 439, 1933.

<sup>4</sup> E. L. Chaffee and E. U. Light, *SCIENCE*, 79: 2048, 299, 1934.

<sup>5</sup> A. T. Mussen, *Arch. Neurol. and Psychiat.*, 31: 110, 1934.

<sup>6</sup> J. E. Ewald, *Verh. Deutsch. Ges. Neurol.*, 25: 180, 1898.

by Lewandowsky,<sup>6</sup> in a few experiments on the cerebellum. Though a search was made of the literature the work of Talbert<sup>7</sup> with this method escaped me as it seems to have escaped most others working on cortical physiology. Talbert working in Munk's laboratory made excellent use of small bipolar electrodes made of two wires set in ivory and screwed into the skulls of dogs which were allowed to live to be stimulated on successive days. Without having been aware of his results we have confirmed Talbert's findings completely.

With Ewald's method Talbert produced movements from stimuli applied to various portions of the cortex, even outside the motor area, and produced epileptic seizures with strong stimuli. He observed that the result of stimulation of a point "remained quite the same, day after day, and experiment after experiment, with no variations save the necessity of stronger currents . . . because of the formation of the cicatrix." He observed that successively stronger stimuli applied

to a single point brought in movements of more and more of the animal's body. He noted that stimuli were less effective when the limbs involved were being used at the time of application of the stimulus, and that a stimulus would interfere with some normal motions, as drinking, but not others as eating. He saw the possibility that position of the animal would affect the response to stimulus, thus predicting Ward's demonstration that cortical stimulation in the intact animal is concerned with a "final position" of the responding part.<sup>8</sup> Had Talbert's work been fully appreciated at the time it was reported, much of the doubt about the constancy of response of cortical points could have been avoided. Though late, I would like to record Talbert's priority in the use of the method of implanted electrodes and express my appreciation of the keenness of his observations which we have had the pleasure of observing independently.

SAM L. CLARK

VANDERBILT UNIVERSITY

## SCIENTIFIC BOOKS

### MATHEMATICAL TABLES

*Mathematical Tables. Vol. IX. Table of Powers Giving Integral Powers of Integers.* BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. xii + 131 pp. Cambridge: At the University Press; New York: The Macmillan Company. \$4.25.

THIS table was initiated by J. W. L. Glaisher and extended by W. G. Bickley, C. E. Gwyther, J. C. P. Miller and E. J. Ternouth.

Around the end of the last century Dr J. W. L. Glaisher computed and prepared to print a table giving the first twelve powers of the first thousand numbers. At least one proof copy was run off, but the table was never published and all copies of it disappeared from view. In recent years, Dr. L. J. Comrie made a determined search for a copy and in 1935 finally found a lone proof copy in the possession of Mr. H. J. Woodall, who generously donated it for use in the formation of the present table.

The present table gives an extension of Glaisher's table in two directions. The first twelve powers of the numbers from 1001 to 1099 are added and also higher powers of numbers less than 300. These additions are not inconsiderable, but Glaisher's original table is the source of over 60 per cent. of the entries of the present table.

In checking Glaisher's table, the computers had a great piece of luck. In the WPA project for the computation of mathematical tables, a table of the

first ten powers of the first thousand numbers had just been prepared. Dr. A. N. Lowan presented a manuscript of the WPA table to the computers of the present table. It should be said in credit to both Dr. Glaisher and the WPA computers that no errors were found in the WPA table and only one error (an obvious missing digit) in Glaisher's.

Glaisher's eleventh and twelfth powers were checked by differencing, which is particularly suitable for checking a table of integral powers of integers.

The powers not in Glaisher's table were checked by adding up powers of consecutive integers and checking the sums by a separate computation of  $\sum_{x=1}^X x^n$  from the formula. The coefficients of this formula for  $n=1, 2, \dots, 50$  are included in a short table at the end of the table of powers. The ten errors brought to light in this way were tracked down by use of remainders modulo 101.

All the checks mentioned were applied to the proof sheets rather than to the original computations. As a further check, page proof was compared with the original computations or with Glaisher's proof. Numerous minor checks were constantly employed throughout the preparation of the table.

As indicated earlier, the present table contains the first twelve powers of the integers from 1 to 1099 inclusive. Higher powers of numbers less than 300 appear as follows:

Integers from 1-299; first 20 powers.

Integers from 1-120; first 27 powers.

<sup>8</sup> J. W. Ward, *Jour. of Neurophysiology*, 1: 463, 1938.

<sup>6</sup> M. Lewandowsky, *Archiv. für Physiologie*, 129, 1903.

<sup>7</sup> G. A. Talbert, *Archiv. für Physiologie*, 195, 1900, *Philadelphia Medical Journal*, 4: 1024, 1899.

Integers from 1-99; first 30 powers.

Integers from 1-120; powers 30, 40, and 50.

In addition, at least the first twenty-one digits are given of all the first 50 powers of the integers from 1-120. The duplications in my description of the table do not occur in the table itself. For instance, the first twelve powers of the integers 1-99 only occur once, in spite of the fact that they occur in four of the categories listed above. Also the first twenty-one digits are tabulated only for those powers which are not given in full. Considering the awkward sizes of

many of the powers, slight deviations from the natural ordering are necessary for economy of space. However, the arrangement chosen is quite uniform, and if the user will take the trouble to go through the table once with some care, he will catch onto the system used, and will find that he can then locate entries easily.

A useful list of other particularly extensive tables of powers is given with descriptions and lists of errors.

BARKLEY ROSSER

CORNELL UNIVERSITY

## SOCIETIES AND MEETINGS

### THE ALABAMA ACADEMY OF SCIENCE

UPON invitation of Spring Hill College, the Alabama Academy of Science held its eighteenth annual meeting in Mobile, Ala., March 21-22, 1941, with the president of the academy, C. M. Farmer, presiding. The Southern Association for the Advancement of Science met at the same time, as the guest of the academy. An address of welcome was made by Father Wm. D. O'Leary, president of Spring Hill College. The Junior Academy was in session simultaneously at the Murphy High School, with over two hundred delegates in attendance representing twenty-five high schools. One of the features of the meeting was a series of exhibits put on jointly by the junior and senior academies under the auspices of C. M. Pomerat, *chairman*, Department of Biology, University.

The executive and business meetings were held on Friday, and the scientific papers were presented on Friday afternoon and Saturday morning in seven sections, the vice-presidents of the academy serving as chairmen of their respective sections. They were as follows: H. D. Jones, Biology and Medical Science, Alabama Polytechnic Institute, Auburn; L. M. Hobbs, Chemistry, University of Alabama, University; D. L. DeJarnette, Geology, Anthropology and Archeology, Alabama Museum of Natural History, University; J. Allen Tower, Geography, Conservation and Allied Subjects, Birmingham-Southern College, Birmingham; W. A. Moore, Physics and Mathematics, Birmingham-Southern College, Birmingham; C. A. Basso, Industry and Economics, Alabama Polytechnic Institute, Auburn; Clustie Evelyn McTyeire, Teaching of Science, Hueytown High School, Bessemer.

At the annual banquet held at the Admiral Semmes Hotel on Friday evening, Father Anthony J. Westland, S.J., served as toastmaster. The address of welcome was by Mayor Cecil F. Bates, Mobile, with response by Septima C. Smith, University. Several musical numbers were rendered by the Jadek String Quartette. President Farmer's address was on the

timely subject, "Science Education." Guests of the occasion were visitors to the Southern Association for the Advancement of Science, which was organized at this time.

Spring Hill College was host to the academy for a very lovely buffet luncheon at College Inn on the campus Saturday at noon.

One of the features of Saturday was the Geology Field Trip arranged by Winnie McGlamery and D. L. DeJarnette, to the marine outcrop of Pleistocene on Mon Louis Island. Saturday afternoon was devoted to motor trips along the Azalea Trail and the beautiful Bellingrath Gardens, and to various industrial centers of Mobile.

The academy award from the American Association for the Advancement of Science for 1941 was divided between Herman D. Jones, Alabama Polytechnic Institute, for his subject, "To Study the Distribution of Arsenic in the Body Following the Use of Water in which Smoke from Cigarettes has been passed through," and W. F. Abercrombie, Howard College, for his study on "The Effects of Various Chemicals on the Cockroach."

New officers for 1941-42 were elected as follows: *President*, Paul D. Bales, Howard College, Birmingham; *President-elect*, W. M. Mobley, Alabama By-Products Company, Tarrant; *Vice-Presidents and Section Chairmen*—Alvin V. Beatty, Biology and Medical Science, University; Harold E. Wilcox, Chemistry, Howard College; E. F. Richards, Geology and Anthropology, University; Brooks Toler, Geography, Conservation and Allied Subjects, Division of Forestry, Montgomery; W. A. Moore, Physics and Mathematics, Birmingham-Southern College, Birmingham; John Goff, Industry and Economics, Alabama Polytechnic Institute, Auburn; Clustie E. McTyeire, The Teaching of Science, Hueytown High School, Bessemer. Septima C. Smith, Biology Department, University, was chosen as councilor to the American Association for the Advancement of Science. John Xan, Howard College, was re-elected treasurer. E. V.

Jones, Birmingham-Southern College, continues for another year as editor of the *Journal*; and Winnie McGlamery, Alabama Geological Survey, as secretary, for two more years. R. M. Harper, Alabama Geological Survey, continues in office as academy statistician. The three new committees for promoting the interests of the academy appointed the previous year have the following officers: Committee on Promoting Membership and Activities, E. D. Emigh, *chairman*, Weather Bureau, Montgomery; Committee on Research, S. J. Lloyd, *chairman*, Dean School of Chemistry, University; Committee on Publication, E. B. Carmichael, *chairman*, Medical School, University, with the editor as an *ex-officio* member.

WINNIE MCGLAMERY,  
*Secretary*

### THE MARYLAND ACADEMY OF SCIENCES

THAT the advancement in the social control and the direction of man's affairs has not kept pace with the conquest of natural phenomena and the application of scientific knowledge to the improvement of the physical conditions of living is an old story.

In this regard many scientists and scientific institutions are becoming conscious that science has a responsibility that extends beyond the production of new knowledge. This responsibility involves the interpretation of science to the citizen not alone for the sake of science, but more to widen mental horizons of the citizen and to develop to some extent an acceptance and willingness to control judgments and actions by scientific criteria. The ideals of scientific inquiry such as tolerance toward the opinion of others, dependence upon verifiable facts, suspended judgment in the face of insufficient evidence, etc., are closely akin to the ideals of a democratic society.

It is rather usual for scientific societies and academies of science to honor individuals for their research contributions in the advancement of science. It is somewhat less usual, if not unique, to pay tribute to scientists for their contribution to the extension of human enlightenment in the field of general education of the lay public.

Such tribute was paid at the annual meeting of the Maryland Academy of Sciences in Baltimore when, for the first time, Professional Fellowships were

awarded to the following persons: Louise Kelley, Ph.D., professor of chemistry, Goucher College; Carroll F. Merriam, engineer, Pennsylvania Water and Power Company; Reginald V. Truitt, Ph.D., professor of zoology, University of Maryland; Robert W. Wood, Ph.D., professor of experimental physics, The Johns Hopkins University.

The citation states that honor was conferred "in recognition of participation in a program dedicated to the extension of human enlightenment through general understanding of the facts and methods of science. This participation is evidence that the recipient accepts the responsibility of applying the values of science to widening the horizon of human understanding." Specifically, this award was extended to Mr. Merriam for his creation and preparation for the last three years of the Maryland Academy of Sciences' Graphic Time Table of the Heavens which has received extensive distribution through the Academy in Baltimore and The Franklin Institute in Philadelphia; and which was published this year as a feature of the astronomical magazine, *The Sky*. The other three scientists mentioned were honored because of their service weekly for twenty-nine weeks on the radio program, "Quiz the Scientist," sponsored by the Maryland Academy of Sciences. This program answered some 150 of the 1,000 questions sent in by people of the radio public in all walks of life.

In addition to Drs. Kelley, Truitt, Wood and Page of the regular quiz board, each week a guest scientist from education or industry was invited to join the board in order to answer questions along the line of his specialty. Our list of guests is much too extensive to be repeated here, but it is very significant that leaders in science, medicine and industrial research were sufficiently convinced of the value of the program to contribute their time.

The final broadcast of "Quiz the Scientist" for this season from the Belvedere Hotel was made the central feature of the annual meeting of the Academy for 1941 and about 500 interested persons attended. "Quiz the Scientist" will be resumed in the fall.

J. WALLACE PAGE, JR.,  
*Director*

MARYLAND ACADEMY OF SCIENCES,  
BALTIMORE

## SPECIAL ARTICLES

### THE FALL IN BLOOD PRESSURE ASSOCIATED WITH INTRAVENOUS INJECTION OF TISSUE EXTRACTS<sup>1</sup>

INTEREST in the long-known but still inadequately

<sup>1</sup> This work was aided by a grant from the Commonwealth Fund.

understood vaso-depressor effects of tissue extracts has been augmented with the increasing use of such preparations. Many theories concerning this vaso-depressor phenomenon have been suggested and different methods of removing such activity from ex-

tracts of organs are well known. That these extracts exert a profound effect upon the coagulation of the blood also is well known; this is manifested first by a short positive phase, when the clotting time is markedly and acutely decreased, followed by a prolonged negative phase when the coagulation time is lengthened greatly. The relation of these two phenomena, the vaso-depressor effects and the influence on the coagulation of the blood, is the subject of the following report.

The thromboplastic substance in the organ extract is responsible for the clotting of the blood and the associated positive and negative phases.<sup>2</sup> The positive phase expresses the increased facility for clotting, the negative phase results from agglutination of platelets, reduction of available fibrinogen and increase in circulating heparin.<sup>3</sup> Symptoms associated with the injection of a tissue extract relate themselves in part to the content of thromboplastic substance and its influence on blood coagulation. Crude kidney extract, rich in such thromboplastic substance, produces intravascular clotting, excitement, nystagmus, loss of sphincteric control and even loss of consciousness. This is true for the crude extract of the majority of organs. It should be recorded that intra-vascular clotting so produced is accompanied by an initial and marked drop in pressure of the blood in the anesthetized (Nembutal) dog.

Variations in the symptom complex, including the drop in blood pressure, are dependent upon several factors, including the initial clotting time of the animal's blood, the speed and the amount of the organ extract injected and its content in thromboplastic substance. Many conflicting observations concerning the presence of both vaso-depressor and pressor effects of kidney extracts may be correlated readily on the basis of these facts.

Further evidence of the importance of the thromboplastic substance in association with the vaso-depressor effect is readily available through the observation that a heparinized animal with a clotting time prolonged to 15 minutes or more reacts differently to a large and rapid injection of an organ extract rich in thromboplastic substance, be this crude kidney or testicle, with its much higher content of this material. The clinical symptoms associated with the injection in such a heparinized animal are lacking. A temporary and moderate drop in blood pressure due to non-specific vaso-depressor agents free in the extract and acting directly on the peripheral vessels, replaces the pronounced and protracted drop so characteristic

in the non-heparinized animal. The heparinized blood following a temporary shortening of coagulation time again develops a pronounced negative phase.

When the blood is in the negative phase and its coagulation time may be prolonged to one hour or more, rapid re-injection with extract rich in thromboplastic substance does not result in a characteristic and marked drop in blood pressure. The coagulation time may be shortened and as long as it does not reach dangerous levels from the standpoint of clot formation, there are no symptoms and no shock-like drop in the blood pressure. The conclusion is evident that the drop in blood pressure is secondary to the change in the blood, certainly to the formation of clots and perhaps even to marked change in the physical chemical state of the blood.

It is demonstrable furthermore that the drop in blood pressure occurs through the intermediation of the central nervous system. After severing the spinal cord at the level of the first cervical segment, the injection of tissue extract rich in thromboplastic substance results as usual in intravascular clotting. However, the blood pressure curve is similar to that after preliminary heparinization or when the animal is injected in the negative coagulation phase. In spite of the formation of extensive intravascular clots the drop in blood pressure in the spinal animal is short and shallow and comparable to that caused by vaso-depressor substances that act directly on the peripheral vessels.

It should be stressed that a heparinized animal or one in the negative phase of blood coagulation after an injection of thromboplastic substance responds to a second injection of thromboplastic substance with a slight drop of blood pressure similar to that produced with 25-50 gamma of histamine. The histamine reaction and the short and shallow drop in blood pressure after injection of thromboplastic substance are manifest as well in the spinal animal. These observations are in accord with the known facts concerning the action of histamine on the peripheral vascular bed. It should be noted also that histamine is detectable in small amounts in all tissue extracts and together with other similarly acting, non-specific vaso-depressants, may account for the slight and very transient drop in blood pressure still evident after the shock-like drop elicited by its thromboplastic substance has been eliminated, whether by heparin, negative phase of clotting time or section of the cord.

E. MYLON

H. HOFF

R. KATZENSTEIN

M. C. WINTERNITZ

<sup>2</sup> M. C. Winternitz, E. Mylon and R. Katzenstein, *Yale Jour. Biol. and Med.*, 18: 585, 1941.

<sup>3</sup> Unpublished observations.

### IDENTITY OF AN IODINE-STORING TISSUE IN AN ASCIDIAN

THE thyroid gland, engaged in the fabrication of its hormone, is the only organ in vertebrates capable of withdrawing considerable amounts of iodine from the blood stream and storing it within itself in relatively high concentration. Recently, by the use of iodine which has been made radioactive, and which will therefore affect a photographic plate, it has become possible to provide a graphic demonstration of this property of iodine-accumulation of thyroid tissue.

With this simple test available, it was of interest to determine whether a protochordate, lacking a thyroid gland, but possessing an organ which is considered its morphological homologue, the endostyle, is capable of storage of iodine. For this purpose about 100 of the small littoral tunicate *Perophora unnectens* Ritter were kept for two days at 10° C. in 800 cc of sea-water to which had been added an amount of radio-iodine<sup>1</sup> having a total activity of 150  $\mu$ -curies. The mass of iodine involved, as the sodium salt, was less than 0.1 mg. The half life of this preparation is eight days.

After exposure to the radio-iodine some of the animals were dried on glass slides, and some were fixed in formalin and sectioned serially. The slides, bearing either the whole-mounts or serial sections, were placed in close contact with a sensitive "no-screen" x-ray film. After having obtained a satisfactory radio-autograph of the serial sections, they were stained in haematoxylin-eosin.

Contrary to expectation, the radio-autographs of the whole mounts showed that no tissue within the body proper of the tunicates stored iodine. It was clear, however, that the stolon was capable of iodine accumulation to a degree fully as great as the vertebrate thyroid. Matching of the serial-sections with their radio-autographs demonstrated that the endostyle stored no iodine whatsoever and that the tissue within the stolon responsible for the remarkably strong iodine storage was the stolonial septum.

The stolonial septum, in most of those ascidians possessing this structure, is a reproductive organ, contributing to the formation of buds. The usual source of the stolonial septum is the pharynx in the region of the endostyle (see discussion by Garstang<sup>2</sup>). In *Perophora*, however, the endodermal origin of the septum is not clear, although it is well established that it is the direct source of all endodermal tissue of the bud.<sup>3,4</sup>

<sup>1</sup> The writer is indebted to the Radiation Laboratory of the University of California, and especially to Dr. J. G. Hamilton, for the radioactive iodine used in this work.

<sup>2</sup> W. Garstang, *Quart. Jour. Micr. Sci.*, 72: 51, 1928.

It must be remembered that the iodine which produced the radio-autographs of the serially sectioned animals had remained in the 8  $\mu$  sections after passing through aqueous and alcoholic solutions, alcohol-ether and xylene, and was, therefore, probably organically bound. This activity by the stolonial septum of *Perophora*, resembling that of the thyroid in its ability to remove iodine from the blood stream, bind it organically, and store it in high concentration, would seem to indicate that the endostyle in this animal may not be the homologue of the thyroid, especially when it is noted that the endostyle displayed no such properties. Indeed, Marine<sup>5</sup> has shown that only a small part of the rather complex endostyle in the ammocoetes of cyclostomes is involved in the formation of the thyroid tissue of the adult. The pharyngeal derivation of the stolonial septum in tunicates as well as its demonstrated iodine-storing activity invite the re-examination by modern workers, with improved techniques, of the protochordate homologue of the vertebrate thyroid gland.

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### THE POLARIZATION OF ATMOSPHERIC HAZE<sup>1</sup>

THE partial plane polarization of skylight was discovered by Arago in 1811. The theory of this phenomenon was later developed by Lord Rayleigh and is described in his papers on the more general subject of the scattering of light by small particles. An equally interesting and more important phenomenon is the polarization of atmospheric haze or air-light, the luminous veil which obscures distant landscape objects. Like skylight, the air-light is most strongly polarized in a direction at right angles to the sun, and if  $F_{\max}$  is the fraction of light polarized in this direction, the fraction  $F_{\theta}$  polarized in a direction making an angle  $\theta$  with the direction of the sun is given approximately by the equation

$$F_{\theta} = F_{\max} \frac{\sin^2 \theta}{1 + \cos^2 \theta}$$

provided that  $\theta$  does not depart greatly from 90°. On clear days when the scattering particles are very small,  $F_{\max}$  usually has values between 0.5 and 0.7

<sup>3</sup> A. Kowalevsky, *Rev. Sci. Nat. Montpell.*, 1874.

<sup>4</sup> W. E. Ritter, *Jour. Morph.*, 12: 149, 1896.

<sup>5</sup> D. Marine, *Jour. Exper. Med.*, 17: 379, 1913.

<sup>1</sup> Haze is sometimes defined as particles suspended in the atmosphere, but a definition which is more compatible with the usual meaning of the word and describes observed facts in a more satisfactory manner defines haze as a luminous condition of the atmosphere, which makes haze synonymous with air-light.

and is about the same for all wave-lengths throughout the visible range of the spectrum. When the haze is caused by larger particles suspended in the air,  $F_{\max}$  may be considerably less than 0.5 and seems to be of a selective nature, having larger values for the longer wave-lengths. For haze resulting from particles large in comparison to the wave-length of light, such as those of fog, polarization due to scattering ceases.

The writer has conducted a series of experiments with colored polarizing screens which indicates that the polarization of the air-light may be of considerable importance in the detection of forest fire smokes from high mountain lookout points. When viewed through a combination polarizing screen and red filter, the visual range of distant objects may be considerably increased, because under favorable conditions this filter combination removes a large part (the polarized fraction) of the atmospheric haze. The light given off by smoke from fires spreading in fresh fuel is only slightly polarized; hence such smoke shows up plainly when the surrounding polarized air-light is removed. The light from thin blue smokes, such as are given off by some smoldering fires, is rather strongly polarized and not easily seen through a polarizing screen rotated so as to extinguish the polarized fraction of the light. The use of a polarizing filter is restricted to certain directions with re-

spect to the sun and it can not be used on cloudy days. It is also ineffective for penetrating fog or removing haze caused by particles of condensed water vapor suspended in the air.

The combined phenomena of (1) selective transmission of red light through the atmosphere, (2) polarization of light of all wave-lengths scattered in directions approximately perpendicular to the sun's rays, and (3) for some types of haze the selective polarization of the longer wave-lengths, make the polarizing screen and red filter an effective haze cutting device. The best results have been obtained with this device in long-distance photography, although it is almost as effective for direct visual work. On rather clear days, distant mountain peaks photographed through the filter on panchromatic film show as much detail as is shown on infra-red film with a red filter. Photographed from Mt. Mitchell in North Carolina, high cirrus clouds almost 350 miles away in western Kentucky showed up plainly on panchromatic film, and only the curvature of the earth prevented a visual (or photographic) range greater than this. A neutral polarizing screen is equally effective for removing haze in color photography.

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## SCIENTIFIC APPARATUS AND LABORATORY METHODS

### THE TYPING OF HEMOLYTIC STREPTOCOCCI<sup>1</sup>

THE control of outbreaks of hemolytic streptococcal infection may depend on the prompt identification of the epidemic type of hemolytic streptococcus. Strains from human sources can be typed either by Lancefield's<sup>2</sup> precipitin test or by Griffith's<sup>3</sup> slide agglutination technic. The main difficulty in the typing by either method is the production of satisfactory rabbit antisera. Frequently effective rabbit antisera may be obscured by the existence of a pro-zone when the slide agglutination method is used. The purpose of this report is to call attention to this finding because failure to recognize it may cause good agglutinating serum to be discarded.

In the past we have made a 1:5 dilution of the serum to be tested as recommended by Griffith. Early this year, before discarding a sample of serum, out of curiosity we made serial dilutions of it and were surprised to find that it agglutinated the homologous organism strongly in a dilution of 1:80 in spite of the fact that it failed to do so either undiluted or when

diluted 1:10. This experience has occurred frequently. Examples are shown in Table 1.

TABLE 1  
EFFECT OF DILUTION OF 5 RABBIT ANTISERA ON AGGLUTINATION OF THEIR HOMOLOGOUS HEMOLYTIC STREPTOCOCCI

Dilutions of antiserum	Hemolytic streptococcus				
	Type 1	Type 6	Type 8	Type 11	Type 12
Undil. ....	—	+	—	—	—
1:10 ....	+	+	—	+	—
1:20 ....	1+	2+	2+	2+	+
1:40 ....	1+	3+	3+	2+	+
1:60 ....	2+	3+	3+	2+	1+
1:80 ....	2+	2+	2+	2+	2+
1:160 ....	1+	2+	2+	2+	2+
1:320 ....				2+	1+
1:640 ...				1+	

The dilution of typing serum has additional advantages which should be mentioned at this time. With an optimum antigen-antibody ratio specific agglutination is maximal and almost instantaneous. This helps to distinguish it from non-specific agglutination which may occur after several minutes when some strains of hemolytic streptococci are mixed with rabbit serum.

It has been pointed out by de Waal<sup>4</sup> that in the

<sup>1</sup> This work was aided by a grant from the Fluid Research Fund of the Yale University School of Medicine.

<sup>2</sup> R. C. Lancefield, *Jour. Exper. Med.*, 47: 91, 1928.

<sup>3</sup> F. Griffith, *Jour. Hyg.*, 34: 542, 1934; 25: 385, 1926.

<sup>4</sup> H. L. de Waal, *Jour. Hyg.*, 40: 172, 1940.

typing of hemolytic streptococci cross-reactions can frequently be eliminated by dilution of the serum, and absorption of such sera with organisms of a heterologous type may be unnecessary. This has been our experience.

Lastly, there is the obvious but important point that the amount of available typing serum is considerably increased by dilution.

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# AN AUTOMATIC DEVICE FOR PERIODICALLY DETERMINING AND RECORDING BOTH SYSTOLIC AND DIASTOLIC BLOOD PRESSURE IN MAN<sup>1</sup>

THIS device, which has been developed at the University of Wisconsin as a joint project of the anesthesia and physiology departments of the Medical School, determines both systolic and diastolic blood pressures by the auscultatory method, the method in common use by most members of the medical profession. The machine has been designed so that it can make and record a complete determination of both pressures and allow sufficient rest for the arm of the subject all within 30 seconds. Pressures may therefore be determined at any periodic rate up to one every half minute. The record consists of a graph of the pressure changes in an inflatable cuff placed on the upper arm (the ordinary type of cuff and application used by physicians in determining blood pressures) and a simultaneous record of the sounds over the brachial artery in the ante-cubital fossa below the cuff. The systolic pressure is taken as that pressure corresponding to the first Korotkow phase in these sounds and the diastolic as that corresponding to the fourth Korotkow phase.

The device consists essentially of two parts. One part controls the induction and recording of the necessary cyclic pressure changes in the inflatable cuff; the other is concerned with the detection, amplification and recording of the sounds in the brachial artery below the cuff.

Operation of the device is as follows. The pressure in the inflatable cuff is automatically recorded as it passes through the following events: (a) raising the pressure in the cuff to some desired pressure above systolic in a predetermined length of time which may be varied at will; (b) allowing this pressure to fall to some pressure below diastolic at a rate which may be adjusted; (c) completely deflating the cuff for any desired period of time to allow rest for the arm and to restore circulation. This cycle of events may be

made to take place periodically or non-periodically as desired. The sounds over the brachial artery in the ante-cubital fossa are picked up by a suitable device, amplified and recorded simultaneously with the pressures in the cuff. The amplification may be varied and a limiting device is supplied to limit the oscillations of the recording pen or stylus.

The machine as constructed at Wisconsin accomplishes the pressure cycle by means of electrically operated valves. A Shure Stethophone picks up the sounds which are amplified and recorded by means of a moving coil type of ink writer. Pressures are recorded with an Esterline Angus pressure recorder. The paper drive is controlled so that the tape moves only during the actual determination and not while the arm is at rest.

A typical time distribution for the pressure cycle for recording pressures every half minute is 3 seconds for inflation, 22 seconds pressure fall and 5 seconds for rest. Pressures may be taken every half minute for hours at a time using this distribution with little discomfort to the patient and little interference with the circulation. The advantages of this machine over others is that both systolic and diastolic pressures are determined and recorded consecutively; no continuously inflated cuff or other pressure device which impedes circulation is needed; and once adjusted to the individual patient, it may be left to run unattended for hours.

WARREN E. GILSON  
HAROLD GOLDBERG  
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UNIVERSITY OF WISCONSIN

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<sup>1</sup> Aided in part by a grant from the Wisconsin Alumni Research Foundation.

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## EARTHQUAKE RISK AND ITS ABATEMENT IN CALIFORNIA

By HARRY O. WOOD

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LONG experience has made it certain that the occur-  
rence of earthquakes in and near California, and the  
attendant risk that there is from this cause, are matters  
not well understood by a vast majority of people both  
inside the state and beyond its borders. For the most  
part non-residents overestimate and residents under-  
estimate the risk here from earth shocks. In both re-  
spects so general a want of understanding is disadvan-  
tageous to the region. From every point of view the  
situation calls for clarification.

Manifestly there is some risk—of death, injury and  
loss of property—in every actively seismic region  
where very small earthquakes are frequent, somewhat

larger ones numerous, with the occurrence of shocks  
of small destructiveness every year or two on the aver-  
age, and moderate, large and great earthquakes at  
longer and longer intervals. California is such a  
region.<sup>1</sup> How great is this risk, and how is it spread?  
What can be done to abate it?

Although the following discussion necessarily deals  
specifically with California and the immediately neigh-  
boring region, the general conclusions reached apply  
also to seismic regions elsewhere, including some other  
districts in the United States.

<sup>1</sup> See "Destructive and Near-destructive Earthquakes in  
California and Western Nevada," U. S. Coast and Geo-  
detic Survey, Special Publication No. 191.

## HISTORICAL RECORD

The historical record of earthquakes in California and adjoining territory does not begin until the spring of 1769. Since earthquakes in a seismic region are recurrent geologic phenomena, and so should properly be considered in terms of the geologic time-scale—a scale which can not be divided precisely or appreciated, in brief units of scores or even hundreds of years—the interval since 1769 is far too short to permit any but tentative conclusions to be drawn regarding the true degree of seismicity of the region and the corresponding risk from this. However, the record for this interval in the California region can be compared with those for the same interval, or similar ones, in other regions. On such a basis, possibly an insufficient one, the risk in California appears significantly less than in many other seismic lands such as Chile, Italy, Asia Minor and Japan. Moreover, on this same basis, the risk in and near California is less, and less prevalent—especially with regard to continually impending danger in all places—than appears to be the wide-spread apprehension of large numbers of non-residents, as evidenced by innumerable letters, inquiries, conversations, press comments, etc., emanating from all parts of the country over an interval of many years. Though earthquakes can not be predicted, and a significant shock may occur at any time at some place within the region, as a matter of fact such shocks are by no means frequent in any one district and no such general apprehension is warranted either by the recorded history of shocks or by the probability based on geological considerations. No one in California lives in continual dread or fear of earth shaking.

## PUBLIC INCOGNIZANCE OF RISK

On the other hand, there is some degree of risk, and the geographic spread of this risk over the region is wider than local residents generally realize. Risk is present in many places where people give no heed to it. There are several reasons for this. The historical record of shocks, such as it is, has not been readily available to most residents, and perhaps not very interesting to them. The great shocks, three in number, have occurred in different districts and at considerable intervals—in 1857, 1872 and 1906. The other large destructive shocks, about ten in number, have been separated fairly widely both in time and in place of occurrence, and this is also true in general of the thirty or so large to moderate earthquakes of more local character. Even shocks of small destructive force, though numerous in the region as a whole, usually have not affected any given small districts more than once in an interval of several years; and often they have been so small that the damage done has been very narrowly limited and sometimes of little moment. In

numerous localities people have lived for many years without suffering any damage whatever from earthquakes. The non-destructive felt shocks (excluding aftershocks following strong earthquakes) are not often very numerous in a given place, and frequently they give rise only to a thrill, or hardly that. The exceedingly numerous unfelt shocks registered by seismographs are known to but few who are not students of earthquake occurrence. Memories of strong shaking fade with time, or at least general awareness of such action dies away. The influx of population in the last twenty to forty years has been very large, on the whole increasing rapidly with the years, so that a very considerable part of the people now resident in the California region, including the younger generation, has practically no knowledge of the earthquake record nor any adequate conception of the frequency or spread of shocks. These things, with others, account for the fact that residents in many localities do not realize their risk. For example, quite genuinely a very great part of the people affected by strong shaking in the Long Beach earthquake in March, 1933, were surprised at the occurrence of a destructive local shock centering so close to the thickly settled Los Angeles plain—though persons acquainted with the record well know of the earlier occurrence of even greater shocks in the same district. The public simply does not know or appreciate the wide spread of such risk as there is—a risk which usually can be made negligible by suitable precautions.

## RELATION OF EARTHQUAKES TO FAULTS

In a large number of cases the central areas of the important shocks have been intimately associated with geologic faults, and in some with the fresh offset slipping of these faults right up to the surface. In many cases this is known without any doubt whatever, and in many more any doubt that there may be is so slight as to be negligible practically, while in many others this association with faults is indicated very strongly, though the information in the historical record, not assembled by scientific men, may be insufficient to demonstrate such a relationship conclusively. It is generally held that most earthquakes are caused by the sudden release of elastic strain when this becomes greater than the strength of the rock, or more commonly of the cohesion or adhesion and friction in a zone of faulting previously broken and displaced—with new or renewed slipping, vibration and the radiation of elastic waves from the place of rupture, the source or origin of the shaking. Our knowledge on this point is not strictly conclusive, but this is the best judgment of qualified men of science, and this view has been widely accepted by well-informed members of the public. There is, however, an imperfect general

understanding of it and its practical meaning. It appears to be thought by almost all laymen that danger from shaking is confined to the very close vicinity of the fault source. Thus it happens that there are many inquiries from more far-seeing individuals and corporations regarding the location and course of faults, in the desire to avoid their immediate neighborhood in the erection or rental of residences or other buildings or works of construction. Wise as this attitude is in many circumstances, it is not sufficiently understood that close proximity to an active fault—which will sometime give rise to a significant earthquake—is only one of the factors, and usually not the most important one, in the risk or danger from shock occurrence. Such risk is far more widely spread. Of course, when the fault slipping extends up to the very surface of the ground any structure which is built astride the crack or cracks along which displacement takes place is bound to be damaged or destroyed unless it is constructed so strongly that it can ride along on its foundations on one side of the crack, leaving behind its foundations on the other—even in such a case extensive repairs will almost always be required, and any occupants will be subjected to great hazard and a very terrifying experience. Usually, however, the fault slipping does not extend up to the surface. And often, perhaps usually, the rocking and shaking is not so violent at the very *innermost* part of the central area, the so-called epicenter or epicentral tract, as at some *small* distance away from it. Thorough discussion of this relationship would require much space. Brief discussion may not be clear to all readers.

#### EARTHQUAKE WAVE-MOTION

However, this relationship appears to be due in part to the angle of emergence of the shock waves—strictly vertical vibration being less destructive to works of construction, built to withstand vertical stresses, than inclined or horizontal vibration; but even more to the *apparent* fact, which has strong theoretical support, that the *surface waves* (which seem usually to be far more destructive than the *elastic body waves* which first come up to the surface from the deep source of the shock) are generated and developed more effectively at *small* distances from the epicenter than at the epicenter itself. The size, shape and geographic location of the areas where these surface waves may be most effectively developed will depend not only upon the depth of the origin but also upon the mechanism or way of slipping of the fault. About this latter relationship we do not know very much as yet.

Of these surface waves there are surely two, probably three and possibly more kinds. There are two *elastic surface waves*, which have larger amplitudes of vibration than the original body waves. One of these

vibrates parallel to the surface and at right angles to lines along the surface radiating from the epicenter. The other vibrates in elliptical paths in the vertical planes which radiate from the epicenter. Of these the second should be the more destructive.

Further, there may be quasi-elastic, quasi-gravity waves of still larger amplitude. There are countless reports of *visible* surface waves which, if real, must be very destructive, since the amplitudes are described as large (up to two or more feet in the vertical) and the wave-lengths as short (six to twenty feet, more or less), the ground surface presenting a waving appearance like the disturbed surface of a body of water. We know positively that some of these reports are mistaken. It seems probable that most, if not all, are due to unconscious oscillatory disturbances of balance, perhaps to unconscious movements of the eyes, or possibly to a purely optical effect, and that such reported waves did not actually occur in the ground. But it may be possible that they are sometimes real and if so they must be very destructive.

Further still, there is little or no doubt that true gravity waves are set up in loose, wet ground, sometimes with very large amplitudes and very destructive potentiality. Also in such bad ground sometimes permanent wave-like deformation of the surface is observed accompanied by marked destructive effects. These phenomena are observed out to some considerable distance from the fault or epicenter depending on the size and strength of the earthquake.

There is also the possibility of the additive or subtractive combination of all these wave motions, body and surface alike, especially in a shock of prolonged duration, increasing the violence at one place and decreasing it at another. The resultant effect, as a whole, may be very complex.

#### EFFECT OF FOUNDATION GROUND

From the point of view of risk, far more important than this complexity of wave-motion in itself, or distance from the source (within a small range), is the nature of the ground at the surface. The energy or power of the shock, of course, is carried outward from the source by the several wave-motions, but the *effect* produced at the surface is *very greatly* different on different kinds of ground. Over and over and over again it has been observed that destructive effects are less on hard rock than on soft, less on soft rock than on alluvium or sand, greatest on marshy or filled ground, or "made land," especially when the latter are highly charged with water. There are innumerable examples of this, and exceptions to it are very few and of uncertain nature. The effects in San Francisco in 1906 afforded striking and detailed demonstration of it. There was far greater contrast between the damage

caused on the rocky summit of Telegraph Hill and that on the wet "made land" near the Ferry Building—places distant about ten miles from the fault source and less than a mile from each other—than there was on rock or firm ground over a range of twenty miles or more eastward from the Cliff House (which stood some four miles east from the fault). All over the area of the city the damage was far more closely related to the kind of ground at the surface than it was to the distance from the origin of the shaking. It is true, of course, that when *large ranges of distance from the earthquake source* are considered, near localities are more severely affected than far ones; but very bad ground not too distant is a much worse foundation than very good ground quite close at hand. *These facts can not be emphasized too strongly.*

#### GEOGRAPHIC SPREAD OF RISK

It is for the reasons given above that such risk as exists is spread far more widely than is generally known or appreciated. Further, active faults are more numerous than is generally known, and many of them are not shown clearly at the surface. Some probably are yet unrecognized, for some have become known only within the last ten to twenty years. A given locality may be safely distant from one potential source, questionably near another and dangerously close to a third. Not all such sources are equally dangerous, but close proximity to the source of a small or moderate destructive shock may be more dangerous than moderate proximity to the source of a really great shock, foundation ground and building structures being the same in both cases. Close proximity of inhabited places to the origins of earthquakes like those which affected Santa Barbara in 1925 and Long Beach and numerous neighboring cities and towns in 1933, shocks of only moderately large total energy which, nevertheless, were destructive over comparatively small areas and of fairly high strength or intensity locally, show this clearly. Had the Long Beach shock been one of large total energy a great disaster would have resulted.

The wide spread of what risk there is from earth shaking in the California region is not a matter of hypothesis—it is a fact proved by the historical record. Since the earliest shock recorded in 1769, more than two hundred destructive and near-destructive earthquakes have occurred in and near California, including the forty-odd great, large and moderate shocks previously referred to. (Such shocks as the Santa Barbara and Long Beach earthquakes belong in the group of about 30 moderately strong local shocks).

For many years after 1769 inhabited places in California were few, small and mostly separated by large distances. With the gold rush in 1849 people began to come in much larger numbers, but only within the last

two or three decades has the population influx been really large and the number of cities, towns and villages become numerous and closely spaced. This applies with special force to the southern part of the state. Even to this day a great part of the area of California and adjoining territory is practically uninhabited—desert, mountain, forest, range and scantily peopled ranch land. Notwithstanding all this the inhabited places where damage from shock has been reported, at one time or another from 1769 onward, are so numerous and so widely and generally spread throughout the state that hardly any settled district can be considered free from some risk. This remains true, even when the comparatively large areas violently or strongly shaken during the dozen or so greater shocks are disregarded. Moreover, such a historical record as we have, under the circumstances outlined above, shows us only the *absolute minimum* of the geographic spread of risk, for the time interval is very short, approximately 170 years, population for a long time was small and sparsely distributed, and the body of information is very, very incomplete. Many places now inhabited must have been shaken strongly in the earlier years before their settlement, as well as places still unsettled, by shocks of which we have no adequate record, or none at all. If a map could be prepared to show all places in which shaking strong enough to damage structures has occurred since 1769 (if structures had been present like those which have been damaged from time to time in the past) a very large part, perhaps almost all, of California and western Nevada would be included.

#### GEOGRAPHIC VARIATION IN RISK

Although such risk as there is is general and widespread it is not everywhere the same. Between the extremes of greatest risk and least the margin may be wide, and probably it is; but it is extremely difficult with present knowledge to appraise the degree of risk for this, that or the other locality or site. No one knows where or when destructive shocks will originate, nor how large or strong they will be. Consequently no one can say when a particular locality or site will be shaken, nor how strongly. We do know some faults, such as the San Andreas, along parts of which strong earthquakes must originate in the future, as in the past; but we do not know when, nor which part will be affected on any particular occasion, nor how strongly. Other faults are under suspicion. Still others probably exist which are quite unknown to us now.

The important thing which we do know is that "made land" and fills, especially when water-soaked, are certainly dangerous in some localities and probably everywhere; that loose water-charged natural ground is more dangerous than dry compact ground; that soft

rock is less dangerous, and hard rock least dangerous of all. A well-designed and well-built structure on a good rock foundation near the source of a strong earthquake is, in general, in much less danger than a poorly designed, poorly built structure on bad foundation ground considerably more distant from the source. Thus, although there is some risk almost everywhere in the region—on the basis of the historical record the average risk is not great, nor danger always impending at all places. Such as it is, the risk can be greatly reduced if the facts are recognized and suitable precautions taken. On the other hand, if the facts go unrecognized or are disregarded, sooner or later earthquakes will take their toll. For example, the San Francisco shock occurred in 1906; in earlier years, as a matter of history, the Los Angeles plain district had been shaken strongly on several occasions. This was forgotten or disregarded. A great majority of the buildings and structures damaged there by the Long Beach earthquake in 1933 had been built later than 1906. Had the lessons of 1906 been applied to this recent building in the cities and towns of the Los Angeles plain very little damage need have occurred, with little or no loss of life and comparatively few injuries.

#### ABATEMENT OF RISK

Earthquakes can not be prevented, precipitated nor controlled—nor predicted except in a broad general way. The population in California is certain to increase greatly, and more and more cities, towns and villages will come into existence, and most existing centers will grow. Even the rural districts will become much more occupied by people. It follows that the thing to do is to build well and suitably on good ground wherever possible and to take special and adequate precautions in all cases where it appears necessary to build on doubtful or actually bad ground. (There is some ground, like the narrow surface zone of the San Andreas fault, where no important buildings should be built at all). At the present time this applies to all parts of the whole region, even though in the far distant future it may gradually become certain that some districts are, practically speaking, really safe from destructive shaking.

Unfortunately, there is one aspect of the risk as it now exists that will require time for abatement—even if the public should now become thoroughly cognizant of danger from shocks and remain always alert. During the rapid growth of population in recent years, at an ever increasing pace, all sorts of buildings and other works of construction have been built in great number on all kinds of foundation ground. Some construction, good from the earthquake point of view, is on good ground, some on bad ground, some on ground of inter-

mediate quality. Similar statements hold for construction of intermediate, and of bad design and workmanship. Some of this construction can be greatly strengthened at low or moderate cost; some can not. Immediate removal and replacement of all risky construction is a physical and economic impossibility. In the course of time all of it will be removed and most of it replaced. If, beginning now, all replacement is of construction suitable to resist earthquake shaking—gradually the risk will diminish toward a minimum. While we can hardly expect the maximum rate of abatement of risk in this way to be realized, important improvement in this regard can certainly be achieved. It should be stated that a beginning has been made and some progress achieved in the improvement of building codes and legal requirements for the construction of schools and other public buildings, but what is really required is general public realization and demand for suitable design and construction under all circumstances.

For the future the only safe procedure is to design and build well on good ground and with especial precaution on doubtful ground. There is still much to learn as to the better and best ways to design and construct. Studies to this end must go forward steadily even though a good deal is known now.

#### VALUE OF INSURANCE

Some protection against property loss and personal injury—and provision for dependents and heirs in case of death—can be obtained from insurance, but at best this recognizes risk of destructive effects, and these can be prevented in large measure though not eliminated completely by taking into account the wide spread of the danger from shaking and everywhere building well with this in mind. Even from the point of view of insurance this is the best procedure by far, for insurance rates will in time become much lower on good ground and good construction. The best insurance is suitably good construction, and the added cost on new structures is only a small percentage of the total investment. For a long time to come, however, some recourse to insurance policies will be judged necessary or desirable in a great many cases. So long as bad constructional conditions, taking foundation ground into account, remain existent individuals and corporations can protect themselves in considerable measure by selection in the purchase or rental of property and by recourse to insurance. The ideal, however, is the general lessening of danger by good new construction and the strengthening or replacement of old weak structures at the quickest practicable rate. From every unselfish point of view the enlightenment of the public regarding the true spread of risk and how to combat it is emphatically desirable.

## MISLEADING STATISTICS

*Present statistics*, resting on far too slight a basis, indicate the risk to life and limb in California to be small—ridiculously small, less than the risk from common trivial diseases. But this is not a true picture. It is due to the past occurrence of the small number of greater shocks at fortunate times of day. Had the Long Beach earthquake, or that at Santa Barbara, for example, to say nothing of the San Francisco shock, occurred at unfavorable hours the statistical story would be a very different one. Energetic shocks will not always continue to occur at most favorable times of day. Some time one will happen when people are in the streets, or in theaters, churches, schools, etc. Once again the answer is the same: If all buildings are well built the risk will be small. Even panic will be reduced. If bad or unsuitable construction is general disaster or catastrophe will result. The moral is—design and build well on good ground, and in case of doubt insure. There is no other way to security.

To conclude—necessarily the greater part of this article deals with the risk that there is, its geographic spread over the region, and what can be done to lessen it. It is very desirable to fix the attention of residents

upon the actual situation and to persuade them to courses of procedure which will ensure greater and greater safety. On the other hand, as stated in the beginning, the risk from earthquake occurrence in the California region, though more general and widespread than most residents realize, is nevertheless much smaller than most non-residents and some local people commonly think—far less than the risk in many other parts of the country from hurricanes, floods, tornadoes and other natural causes of disaster. In justice to California and neighboring territory emphasis must be placed upon these facts. It would be unfair to the region if efforts to secure in it safe building and construction procedure should be construed as a warning of danger of great magnitude constantly impending at all places. While no one can foretell the future of earthquake occurrence in any practical way, the historical record since its beginning in 1769 gives no warrant for such alarm or serious apprehension. All that is warranted is recognition that earthquakes will continue to occur in the future as they have occurred in the past and that safety from the shaking requires good judgment in the selection of sites and the adoption of suitable resistant methods of construction.

## THE ROLE OF AEROBIC PHOSPHORYLATION IN THE PASTEUR EFFECT

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A DECREASE in rate of carbohydrate utilization upon admission of oxygen is characteristic of many tissues. The various mechanisms which have been proposed for this Pasteur effect have been adequately reviewed by Burk.<sup>1</sup> It is the purpose of this note to call attention to a possible mechanism which does not appear to have been specifically mentioned elsewhere.

This mechanism is, in short, the following: If both aerobic and anaerobic carbohydrate breakdown are necessarily phosphorylative processes, inorganic phosphate and a phosphate acceptor are essential reactants; in their absence neither glycolysis nor oxidation could proceed. The Pasteur effect could then be regarded as the cessation or reversal of glycolysis which takes place when concentrations of inorganic phosphate and phosphate acceptors become low because of the phosphorylative oxidations which occur in the presence of oxygen. The necessary conditions for the operation of this mechanism are:

- (1) The glycolysis reactions must be readily reversible.

<sup>1</sup> D. Burk, *Cold Spring Harbor Symposia on Quantitative Biology*, 7: 420, 1939.

- (2) Phosphorylation (esterification of inorganic phosphate) must be an essential step in both the glycolytic and the oxidative processes.

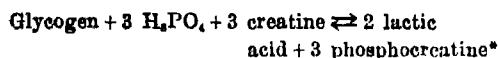
- (3) The oxidative phosphorylation reactions must be capable of reducing the inorganic phosphate (and phosphate acceptor) concentration to a level lower than that attained at glycolytic equilibrium. That is, oxidative phosphorylation must be possible at inorganic phosphate concentrations too low to permit glycolytic phosphorylation.

- (4) The number of molecules of phosphoric acid esterified when one molecule of carbohydrate is oxidized must be greater than the number esterified when one carbohydrate molecule is glycolized.

- (5) The same reservoirs of phosphate ester, inorganic phosphate and phosphate acceptor must be available to both the glycolytic and the oxidative enzyme systems.

An adequate discussion of the likelihood that these conditions are actually fulfilled in isolated muscle can not be given here. Each point can be given only the briefest consideration.

- (1) The glycolysis reaction may be summarized by the following equation:



(The participation of hydrogen ions is neglected for simplicity, although their inclusion would strengthen the argument.) The reactions summarized by the above equation, like any series of enzymatically catalyzed reactions, must necessarily be reversible. Whether appreciable reversal can take place under physiological conditions depends upon the position of the equilibrium point. That the equilibrium falls, in muscle glycolysis, well within the physiological range of reactant concentrations is elegantly illustrated by such data as those of Lundsgaard,<sup>2</sup> which show that after muscular work, glycolysis proceeds only to a definite equilibrium point. High concentrations of lactate occur only in the presence of high concentrations of creatine and inorganic phosphate (and low concentrations of phosphocreatine). High phosphocreatine concentrations and low phosphate concentrations permit the formation of only a limited amount of lactic acid. Experimental demonstrations of the ready reversibility of a number of component reactions of the glycolytic process have been given by Cori and Cori,<sup>3</sup> Ohlmeier,<sup>4</sup> Meyerhof *et al.*,<sup>5</sup> and others.

(2) Phosphorylation has long been recognized as a necessary component part of the glycolysis process. It has also been known that aerobic muscle recovery involves phosphorylation. Thus, Meyerhof and Nachmannsohn<sup>6</sup> showed in 1930 that the oxygen uptake which resulted when oxygen was admitted to fatigued muscle brought about an amount of phosphocreatine resynthesis which was proportional to the amount of oxygen used. The mechanism of this phosphorylation is still unknown. Kalekar<sup>7</sup> and Colowick, Welch, and Cori<sup>8,9</sup> have shown phosphorylations to be in-

involved in biological oxidative processes. While it has not been shown that phosphorylation is an absolutely essential step in these oxidations, such an assumption at least does not appear too difficult.

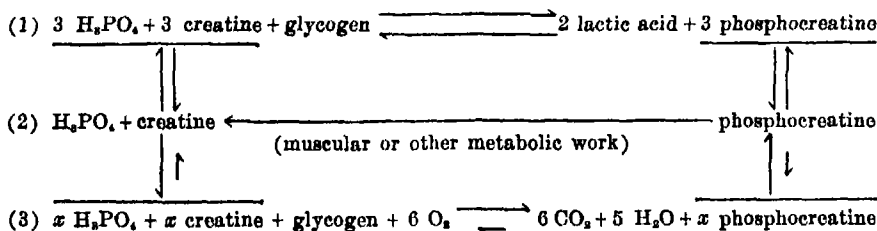
(3) The fact that aerobic phosphorylations are able<sup>6</sup> to restore muscle phosphocreatine concentration to the resting level (with corresponding depletion of inorganic phosphate and creatine), while glycolytic phosphorylation stops far short of this achievement, seems sufficient evidence that oxidative phosphorylation is capable of operating at lower inorganic phosphate levels than is glycolytic phosphorylation.

(4) The number of molecules of inorganic phosphate esterified when one molecule of carbohydrate is completely oxidized has not as yet been accurately determined. Meyerhof and Nachmannsohn<sup>6</sup> concluded that the number is at least 24 (4 to 5 molecules of phosphocreatine synthesized for each O<sub>2</sub> molecule used). There are, however, a number of reasons for believing that this figure may be too high. Colowick, Welch, and Cori<sup>7</sup> recently obtained roughly two molecules of phosphate ester per molecule of O<sub>2</sub> used in pyruvate oxidation. Whatever the true figure may be, there seems to be little doubt that the number of aerobic phosphorylations per sugar molecule far exceeds the number of anaerobic phosphorylations (3 for glycogen, 2 for glucose).

(5) The availability of the same phosphate reservoir in muscle to both aerobic and anaerobic systems seems to be clearly demonstrated by the fact that either aerobic or anaerobic phosphocreatine resynthesis is possible.

On the basis of the above assumptions, the reactions taking place in isolated muscle could be expressed by the diagram below.

**When a resting isolated muscle is stimulated, work**



\* In the present note the simplifying assumption will be made that phosphocreatine, the chief esterified phosphorus reservoir of muscle, is the only reservoir; the intermediation of such compounds as adenosinetriphosphate will be neglected. Since the various phosphate esters are in equilibrium with one another, this assumption is permissible.

<sup>2</sup> E. Lundsgaard, *Biochem. Z.*, 233: 822, 1931.

<sup>3</sup> G. T. Cori and O. F. Cori, *Jour. Biol. Chem.*, 135: 733, 1940.

\* P. Ohlmeyer, *Biochem. Z.*, 283: 114, 1935.

<sup>6</sup> O. Meyerhof, P. Ohlmeyer und W. Möhle, *Biochem. Z.*, 297: 113, 1938.

<sup>6</sup> O. Meyerhof and D. Nachmannsohn, *Biochem. Z.*, 222: 1, 1930.

is done at the expense of energy of phosphorylation (reaction 2). Anaerobic restitution (reaction 1) immediately sets in, and proceeds rapidly toward the right until equilibrium is reached. At equilibrium, very considerable concentrations of inorganic phosphate and creatine still remain. If oxygen is now admitted, aerobic restitution (reaction 3) begins.

<sup>7</sup> H. Kalckar, *Enzymologia*, 6: 209, 1939.

<sup>8</sup> S. P. Colowick, M. S. Welch and C. F. Cori, *Jour. Biol. Chem.*, 183: 359, 1940.

<sup>9</sup> S. P. Colowick, M. S. Welch and C. F. Cori, *Jour. Biol. Chem.*, 133: 641, 1940.

The resulting reduction in inorganic phosphate and creatine and increase in phosphocreatine displaces the equilibrium of reaction 1 toward the left. Glycogen resynthesis then begins, the inorganic phosphate thus produced being continuously reesterified by reaction 3. The mechanism of energy coupling is clear. A part of the energy of carbohydrate oxidation is converted to energy of phosphorylation by the aerobic phosphorylation mechanism. This energy of phosphorylation is then expended in resynthesizing glycogen from lactic acid.

In a steady state of rest or low work output, under aerobic conditions, glycolysis would be regulated by the fact that the aerobic phosphorylations can proceed at a lower concentration of inorganic phosphate than is compatible with an appreciable glycolysis rate. Furthermore, the rate of carbohydrate oxidation will be limited by the available concentration of inorganic phosphate. It would thus necessarily follow that oxidation is slow in the resting state because of the lack of the inorganic phosphate which is essential to the phosphorylative oxidation process. Only the liberation of inorganic phosphate concomitant with metabolic work would permit acceleration of carbohydrate oxidation. When the rate of inorganic phosphate liberation exceeds the rate of oxidative phosphorylation, the resulting accumulation of phosphate will accelerate glycolysis.

In view of the foregoing, the mechanism of the Pasteur effect in muscle and other tissues is readily outlined. Since oxidative phosphorylation is more energetic (*i.e.*, capable of attaining a higher phosphocreatine-creatine ratio) than glycolytic phosphorylation, the admission of oxygen to muscle rapidly reduces the level of inorganic phosphate and raises the phosphocreatine-creatine ratio until a point is reached where glycolysis must begin to reverse. Since the number of molecules of phosphoric acid esterified per molecule of carbohydrate consumed is much larger in oxidation than in glycolysis, a much lower rate of carbohydrate disappearance suffices to maintain a high phosphorylation level in the face of the energy de-

mands for muscular work or other energy-consuming reactions. One measure of the Pasteur effect is the number of carbohydrate molecules protected from glycolysis per carbohydrate molecule oxidized. This quotient should be equal to the ratio of the number of molecules of phosphoric acid esterified when a carbohydrate molecule is oxidized to the number esterified when a carbohydrate molecule is glycolized.

When yeast grows anaerobically its sole source of energy is, as far as present knowledge goes, the two molecules of phosphate ester which are produced when one molecule of glucose is converted into ethyl alcohol and carbon dioxide. In other words, the yeast cell seems able to utilize energy of phosphorylation for every energy requirement of its metabolism. It is only reasonable to suppose that aerobically, the energy of phosphorylation used by the cell is supplied by the phosphorylations accompanying aerobic oxidation. If the respiratory mechanism of yeast is similar to that of animal tissue, it may be assumed that the number of aerobic phosphorylations is sufficiently large to account for the decreased fermentation observed<sup>10</sup> for yeast under aerobic conditions.

The Pasteur effect in yeast, as in muscle, would thus be interpreted as following from the fact that, aerobically, a relatively low rate of sugar utilization suffices to reesterify phosphate as rapidly as it is liberated by energy-consuming metabolic reactions.

Since the foregoing was submitted, the paper of Colowick *et al.* (*Jour. Biol. Chem.*, 137, 343, 1941) has appeared, in which it is concluded that at least 10 atoms of phosphate are esterified per glucose molecule oxidized. This is supporting evidence for point (4) above. Moreover, Cori (Biological Federation Annual Meeting, Chicago, April, 1941) has announced the experimental reversal of the conversion of glucose-1-phosphate into glucose-6-phosphate (point (1) above), and has independently reached the conclusion that energy of aerobic phosphorylation is utilized for carbohydrate resynthesis. Once this conclusion is reached, it becomes difficult to escape consideration of the interpretation of the Pasteur effect outlined above.

## OBITUARY

### GEORGE ELLETT COGHILL

GEORGE ELLETT COGHILL belonged to that small and select group of scientific workers who at the beginning of a fruitful career formulate a specific program of research with a clearly defined objective and thereafter devote themselves consistently and unflinchingly to intensive investigation of the chosen theme. In his case the problem has so wide implications and the results of the inquiry are of so great interest in fields as far apart as comparative embryology and human

motivation that it may safely be said that his work is one of the major American contributions to fundamental biology.

After completing the classical course at Brown University and a year of study in a conservative theological seminary, he found further effort in this direction unsatisfying. In perplexity and mental agitation he retired to the open spaces of the Southwest, where he spent five months of vagrant wandering in northern

<sup>10</sup> O. Meyerhof, *Biochem. Z.*, 162: 43, 1925.

New Mexico. With horse and camp equipment he drifted as the mood directed, alone with his thoughts most of the time, but accompanied occasionally by his younger brother Will, who was then beginning his engineering education. This thinking in solitude culminated in the resolve to study the nervous system as a biological approach to a scientific psychology and a naturalistic philosophy.

This was in late summer, 1897, when a chance meeting with the president of the Territorial University at Albuquerque opened the way toward the accomplishment of his purpose. Three years of apprenticeship with President C. L. Herrick fixed his resolve and defined the objective. Returning to Brown University, he earned the Ph.D. degree in zoology, then taught zoology in three colleges, anatomy at the State University of Kansas, and later occupied a research position at the Wistar Institute of Anatomy and Biology.

He was born at Beaucaup, Illinois, on March 17, 1872. The academic record includes, A.B., Brown University, 1896, Ph.D., 1902; M.S., University of New Mexico, 1899, assistant professor of biology, 1899-1900; professor of biology, Pacific University, Oregon, 1902-1906; professor of biology, College of Arts, and of embryology and histology, College of Medicine, Willamette University, Oregon, 1906-1907; professor of zoology, Denison University, Ohio, 1907-1913; associate professor of anatomy, Kansas State University, 1913-1916, professor, 1916-1925, head of the department of anatomy and secretary of the School of Medicine, 1918-1925; professor of comparative anatomy, Wistar Institute, Philadelphia, 1925-1935. Broken in health, he retired in 1936 to Gainesville, Florida, where he built a dwelling and a small private laboratory and continued his research program as strength permitted until his death, July 23, 1941. Honorary Sc.D. degrees were received from Pittsburgh, Denison and Brown Universities. He was a member of the National Academy of Sciences, American Philosophical Society, American Association of Anatomists (president, 1933), American Society of Zoologists, American Neurological Association (associate) and other scientific societies. He was editorially connected with the *Journal of Comparative Neurology* from 1904 until his death and was managing editor from 1927 to 1933.

The task to which Dr. Coghill addressed himself can be stated very simply.—the correlation of development of patterns of behavior with the progressive differentiation of the organs which execute the behavior. He selected for intensive study a primitive and generalized animal in which the essential features are reduced to simplest terms, the salamander, *Amblystoma*. In this choice he showed insight, for during the span of the forty years of his labor this has proved

to be the most serviceable type for a wide range of experimental researches. In this program he broke new ground in both aim and methods of work.

The first step was the determination upon statistically adequate numbers of specimens of the actual sequence of development of patterns of overt behavior characteristic of this species. A series of specimens, each of which was known by test to have reached a specific stage in this physiological scale, was then examined microscopically to detect the structural changes in internal organization correlated with the successive steps in the growth of the action system.

Most of the factual material published is included in the twelve parts of his "Correlated Anatomical and Physiological Studies of the Growth of the Nervous System of Amphibia."<sup>1</sup> These papers are models of close, accurately controlled observation and clear description, but the technical details are hard reading for any but experts in the field. As the mass of data began to reveal meaning to his mind he published from time to time brief summaries and interpretations. These papers are listed in the bibliography to be published.<sup>2</sup> The most important of them are the lectures on "Anatomy and the Problem of Behavior" delivered in London (Cambridge University Press, 1929) and the presidential address before the American Association of Anatomists on "The Neuro-embryologic Study of Behavior: Principles, Perspective and Aim."<sup>3</sup>

This was pioneer work, the first and until now the most complete account of the actual relationship between progressive differentiation of bodily structure and the operations of that structure as manifested in the maturation of patterns of overt behavior. The accuracy of the observations has been checked by numerous other observers and the conclusions drawn from them seem to be valid for the material studied. Caution must be observed in the extension of these principles to animals differently organized and with different developmental history. These questions will be clarified in due time, for many similar studies are now in process on the development of other animals from fishes to man.

The most important and far-reaching result of this series of researches is the impressive demonstration of the unity and integrity of the organism, the dominance of the "total pattern" over "partial patterns" at all stages of normal development, and illustrations of types of structural organization which perform both the integrative and the analytic functions. Dr. Coghill's original interest in the psychological and philosophical implications of his observations never waned, but unfortunately little of his thinking in these fields

<sup>1</sup> *Jour. Comp. Neur.*, 1914-1936.

<sup>2</sup> *Jour. Comp. Neur.*, Vol. 75, October, 1941.

<sup>3</sup> *SCIENCE*, Vol. 78, 1933.

came to expression in print. Scattered comments in his lectures and theoretic papers show that his comprehension of the significance of his observations for psychology and philosophy was clear-cut and profound.

C. JUDSON HERRICK

THE UNIVERSITY OF CHICAGO

### HARRY MILTON WEGEFORTH

HARRY MILTON WEGEFORTH, M.D., born in 1882, in Baltimore, Maryland, died in San Diego, California, on June 25, 1941, at the age of 59. He was a graduate of Maryland University in 1906. He practiced as physician and surgeon in San Diego from 1910 until 1935.

In 1916 he became interested in founding, organizing and developing the San Diego Zoo. He served as its president from its inception until his death, nearly 25 years. His first objective for the Zoo was to make it of value to the children of the community. To attain this objective, he pioneered many modern procedures; barless moated grottoes, animal family groups and lecture bus trips. To make the Zoo more realistic, he obtained plants from the countries from which the animals came and tried to make the entire background reflect the home environment.

He sponsored an animal hospital and research laboratory making available full utilization of animal exhibits both during exhibition and death for scientific

study. Research fellowships made possible the study of special problems in animal health.

By his leadership and example, he gained the confidence and support of the many friends that have made the San Diego Zoo a monument to his memory.

W. C. CRANDALL

LA JOLLA, CALIF.

### RECENT DEATHS

DR. CHARLES BRANCH WILSON, biologist, from 1897 to 1932 head of the department of science of the Massachusetts State Teachers College at Westfield, died on August 18 in his eightieth year.

DR. ELLISON ADGER SMYTH, JR., until his retirement in 1925 professor of biology and from 1903 to 1906 dean of the faculty at Virginia Polytechnic Institute, died on August 19 at the age of seventy-seven years.

DR. JOHN MORPHY SNELL, since 1937 research chemist of the Eastman Kodak Company, died on August 8 in his thirty-fifth year.

A CORRESPONDENT writes: "Dr. Mataro Nagayo, formerly president of the Tokio Imperial University, Japan, director of the Japanese Foundation for Cancer Research, and the editor of *Gann*, the Japanese journal of cancer research, died on August 16 at the age of sixty-three years. In recognition of Dr. Nagayo's achievements, the Emperor of Japan conferred on him the title of Baron."

## SCIENTIFIC EVENTS

### FIELD WORK IN GEOLOGY IN CANADA

A PROGRAM of field work comprising the mapping and examination of many thousands of square miles of mineral areas throughout the Dominion of Canada is being undertaken this year by the Mines and Geology Branch, Department of Mines and Resources, Ottawa. Twenty-seven geological parties and nine topographical parties have been assigned to the work. A feature of the program is the investigation being made of possible commercial sources of tungsten, chromite and manganese, three of the strategic minerals, the production of which in Canada has been small.

Two of the geological parties are working in the Northwest Territories, one in Yukon, six in British Columbia, four in Alberta, one in Saskatchewan, one in Manitoba, two in Ontario, six in Quebec, one in New Brunswick and three in Nova Scotia. Two of the topographical parties have been assigned to British Columbia, two to Alberta, three to Quebec and two to Nova Scotia.

The program includes the following projects:

In British Columbia five of the geological parties are engaged in the mapping of areas in which deposits of mercury, chromite, gold, copper and other minerals occur, as an aid to prospecting and development. The areas are being mapped on a four-mile scale and have a total area of approximately 15,000 square miles. Another party is reexamining the geology of an important gold-producing area. A. F. Buckham is reexamining the Barkerville gold belt in the Cariboo district. Since 1934, when the area was last examined, its gold production has shown a threefold increase and developments at depth have disclosed structures, the relationship of which to the gold deposition is not clearly defined. The work in Alberta and Saskatchewan is part of the general effort to aid in the search for new oil fields. The Province of Alberta is the source of about 96 per cent. of Canada's annual output of crude petroleum.

In Quebec the geological and topographical exploration of the 40,000-square mile region east of James Bay, in charge of G. Shaw and J. Carroll, is one of the largest projects undertaken by the Mines and Geology Branch in recent years. The purpose is to produce an 8-mile-to-the-inch exploratory map; to outline areas favorable for prospecting, and to indicate the main travel routes. At

the request of the Metals Controller, investigation of the chromite deposits of southeastern Quebec is being continued. C. H. Stockwell is making the detailed investigations of the chromite-bearing rocks and is carrying out geophysical work for the purpose of locating deposits of the mineral. J. W. Ambrose is examining the igneous formations in which chromite occurs.

In New Brunswick F. J. Alcock is supervising the prospecting for deposits of manganese along the northwestern flank of Caledonia Mountain. The project is being undertaken at the request of the Provincial Government.

In the Yukon H. S. Bostock is continuing the geological mapping of the McQueston area near Keno on a four-mile scale. Rocks in the area contain tungsten, silver, lead and other minerals. He is also investigating occurrences of placer tungsten on Canadian Creek and is collecting information for use in a report on mining operations in Yukon.

In the Northwest Territories A. W. Jolliffe has been engaged in investigating the Gilmour Lake area about fifty miles due east of Yellowknife settlement as an immediate source of scheelite, an ore of tungsten.

#### THE AMERICAN COORDINATING COMMITTEE ON CORROSION

THE third annual meeting of the American Coordinating Committee on Corrosion was held on August 6 at Gibson Island, Md. The meeting was planned to coincide with the first Symposium on Corrosion, sponsored by Section C of the American Association for the Advancement of Science with the assistance of this coordinating committee. Dr. R. M. Burns, assistant chemical director of the Bell Telephone Laboratories, was chairman of the symposium. It was attended by approximately seventy invited specialists. The coordinating committee has offered its services to Section C to insure similar symposia in future years.

At the official committee meeting Dr. F. N. Speller, representing the American Chemical Society and the National Research Council, was reelected chairman for the year 1941-42; Dr. R. M. Burns, representing the Electrochemical Society, was named vice-chairman; and Dr. G. H. Young, of the Mellon Institute of Industrial Research, was named secretary-treasurer. Committee headquarters are at the Mellon Institute, Pittsburgh, Pa.

The committee was organized three years ago under the auspices of the American Society for Testing Materials to coordinate research activities in this field, and is patterned after similar organizations abroad. It has been functioning as an independent body for the past two years. As its first contribution, it undertook to survey existing investigations on corrosion in this country. Requests for information were submitted to some six hundred individuals and companies, through the executive offices of the member organizations of the committee. From the data thus accumulated the committee issued in 1940 a confiden-

tial directory of corrosion investigators and a classified list of subjects, which was sent to all those officially listed in the directory. This directory has now been expanded to include additional investigators and to broaden its subject classification. The revised directory was released on August 15.

The committee is at present composed of official delegates from the American Chemical Society, American Electroplaters Society, American Foundrymen's Association, American Gas Association, American Institute of Chemical Engineers, American Institute of Electrical Engineers, American Institute of Mining and Metallurgical Engineers, American Society of Heating and Ventilating Engineers, American Society of Mechanical Engineers, American Society for Metals, American Society of Refrigerating Engineers, American Society for Testing Materials, American Water Works Association, American Welding Society, Battelle Memorial Institute, Copper and Brass Research Association, Electrochemical Society, Mellon Institute of Industrial Research, National Bureau of Standards, National District Heating Association, National Research Council, Society of Automotive Engineers and the Technical Association of Pulp and Paper Industry.

#### REPORT OF THE SUBCOMMITTEE ON EDUCATION FOR SERVICE OF THE AMERICAN MATHEMATICAL SOCIETY AND THE MATHEMATICAL ASSOCIATION OF AMERICA

A REPORT of activities and recommendations was recently presented to Professor Marston Morse, chairman of the War Preparedness Committee of the American Mathematical Society and the Mathematical Association of America by its Subcommittee on Education for Service. The active members of the subcommittee, who subscribe unanimously to the report are: R. S. Burington, H. B. Curry, E. C. Goldsworthy, W. L. Griffin, W. L. Hart, M. H. Ingraham and E. J. Moulton.

According to the report:

In arriving at an estimate of the mathematical background which is desirable for workers in government and industry, and for officers and enlisted men in the Army and Navy, we recognize the validity of the following pedagogical viewpoint: In order that an individual may be able to use effectively any particular body of technique, his school training should extend a reasonable distance beyond the level of difficulty at which he will apply the technique. Thus, if we wish to prepare a student so that, later, perhaps after some review, he can use elementary algebra, he should be exposed to advanced algebra, or to some other mathematical subject with elementary algebra as a prerequisite. This pedagogical viewpoint is at variance with emergency actions which would attempt to

give men the bare minima of mathematical techniques necessary for a formal approach to their applications. An emergency justifies any remedial action, but our efforts should be directed toward making it unnecessary to use hazy emergency shortcuts to mathematical procedures. With our wide-spread democratic system of secondary and collegiate education, our nation is justified in demanding that we should always have on hand a relative surplus of people with mathematical training through substantial secondary mathematics and also a surplus with elementary college training in the subject.

Further recommendations are taken up under the following headings: Statement of general viewpoints; Recommendations concerning mathematics for those in non-military activities; Evaluation of the mathematical needs of the Army and Navy; Conclusions drawn from results of the program of reviews of books of a mathematical nature used by the Army, Navy and Civil Aeronautics Authority; Recommendations concerning the field of secondary mathematics, and Curricular recommendations at the college level.

#### ELECTION TO BEIT MEMORIAL FELLOWSHIPS

A MEETING of the trustees of the Beit Memorial Fellowships for Medical Research was held on July 25. It is stated in the *London Times* that out of the 30 present fellows 13 had already been seconded at their own request for more direct service during the war, and that six others have undertaken some research work for Government Departments on problems arising out of the war.

The following elections were made, all with permission for each fellow to be seconded at any time for war duties:

*Senior Fellowship* (£700 a year).—T. R. R. Mann, M.D. (Lwow, Poland), Ph.D. (Cambridge).—To continue his work on intra-cellular metallo-protein compounds, especially of red blood cells. At the Molteno Institute of Biology, University of Cambridge.

*Fourth Year Fellowships* (£500 a year).—J. F. Danielli, B.Sc., Ph.D. (London).—To continue his work on the permeability of muscle fibers and of capillaries. At the Biochemical Laboratory, University of Cambridge.

Miss C. O. Hebb, M.A. (Dalhousie), Ph.D. (McGill University).—To continue her studies of physiological problems in relation to high altitudes. At the Department of Physiology, University of Edinburgh.

H. Lehmann, M.D. (Basle), Ph.D. (Cambridge).—To continue his work on the influence of shock and of the suprarenal glands on glycogen synthesis. At the Biochemical Laboratory, University of Cambridge.

*Junior Fellowships* (normal value £400 a year).—E. F. Gale, B.Sc. (London), Ph.D. (Cambridge).—1851 Exhibition Senior Student, Fellow of St. John's College, Cambridge.—To study bacterial amine production as a cause of non-specific infantile diarrhoea. At the Biochemical Laboratory, University of Cambridge.

W. Holmes, B.A. (Oxford), Christopher Welch Scholar in Biology, Senior Demy of Magdalen College.—To study the regeneration of nerve fibers after injury. At the Department of Zoology, University of Oxford.

Miss M. F. Lockett, M.D. (London), M.B.C.P., Owen-Roberts memorial scholar, London School of Medicine, research student in pharmacology, Cambridge.—To identify renal pressor substances responsible for experimental high blood pressure. At the Pharmacological Laboratory, University of Cambridge.

#### REPRESENTATION BY INSTITUTIONS AT THE MARINE BIOLOGICAL LABORATORY

The *Collecting Net* reports that there are 278 investigators present this summer at the Marine Biological Laboratory, Woods Hole, as compared with 293 at the same time last year. The following institutions are represented by three or more investigators:

Institution	1941	1940
Pennsylvania	30	34
New York	23	21
Columbia	18	22
Yale	13	8
Hopkins	12	8
Harvard	9	7
Ohio State	9	8
Chicago	8	13
Rockefeller Institute	8	9
Michigan	7	4
Princeton	7	5
Brown	6	5
Cornell	6	6
Pittsburgh	6	7
Cincinnati	5	4
Lilly Laboratories	5	4
Milton Academy	5	4
Vassar	5	2
Villanova	5	2
Washington	5	5
California	4	5
California Tech.	4	2
Iowa	4	4
Mt. Holyoke	4	2
Queens	4	4
Rochester	4	2
C. C. N. Y.	3	3
Illinois	3	2
Miami	3	2
Minnesota	3	2
Missouri	3	6
Oberlin	3	3
Syracuse	3	5
Temple	3	3
Toronto	3	5
Union	3	4
Williams	3	3

#### THE CHICAGO MEETING OF THE ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

THE forty-sixth annual meeting of the American Academy of Ophthalmology and Otolaryngology will be held at the Palmer House, Chicago, from October 19 to 23, under the presidency of Dr. Frank R. Spence, of Boulder, Colo.

The program consists of one general scientific meeting on the morning of the first day, separate programs for the two specialties on alternate afternoons and instructional courses every morning beginning on Tuesday.

The feature of the general opening meeting will be a symposium on vertigo, with Dr. Francis H. Adler, Philadelphia, representing ophthalmology; Dr. William J. McNally, Montreal, otolaryngology, and Dr. Bernard Alpers, Philadelphia, neurology.

During the convention there will be various meetings of small groups, including the "Teachers' Section," secretaries of local eye, ear, nose and throat societies and alumni organizations. The meeting of the teachers' section will be concerned especially with the role of the academy in national defense during the present emergency. There will also be a scientific exhibit that will include such subjects as "Ocular Conditions in Children Due to Systemic Disease," "Conduction of Sound in the Ear," "Hemophilia and Other

Blood Dyscrasias as Manifest in the Eye, Ear, Nose and Throat," "Cancer of the Larynx" and "Significance of the Eyegrounds in the Problem of Hypertension."

Alternating with the scientific programs each afternoon will be an elaborate motion-picture program. Thus when the section of ophthalmology is meeting for formal presentation of papers, motion pictures on otolaryngology will be available for those interested in that field.

Dr. Perry Goldsmith, professor of otolaryngology in the University of Toronto Faculty of Medicine, Toronto, Ont., will be the guest of honor this year.

Officers of the academy in addition to Dr. Spencer are Drs. Ralph Irving Lloyd, Brooklyn, *president-elect*; Everett L. Goar, Houston, Texas; James M. Robb, Detroit, and Ralph O. Rychener, Memphis, Tenn., *vice-presidents*, and Secord H. Large, Cleveland, *comptroller*. Dr. William P. Wherry, Omaha, Nebr., is executive secretary-treasurer.

## SCIENTIFIC NOTES AND NEWS

DR. WILLIAM DE B. MACNIDER, Kenan research professor of pharmacology at the University of North Carolina, who retired in July as dean of the Medical School, has been elected president of the Society for Experimental Biology and Medicine.

THE honorary degree of doctor of science has been conferred by the College of Wooster on Dr. Benjamin Harrison Willier, professor of zoology and chairman of the department of biology at the Johns Hopkins University.

DR. C.-E. A. WINSLOW, Lauder professor of public health at the School of Medicine of Yale University, has been appointed Rosenberg lecturer in the Public Social Services at the University of California for the fall semester of 1941. He will give two courses in the department of Social Welfare, one for undergraduates and one for graduate students, and will offer a lecture series open to the general public. In addition it is expected that he will travel throughout California to speak to various groups. The lectureship was established two years ago by the Rosenberg Foundation of San Francisco for the purpose of bringing to the university for one semester at a time distinguished authorities on the public social services.

THE second Sanford E. Thompson Award "for outstanding merit on concrete and concrete aggregates" presented at an annual meeting of the American Society for Testing Materials has been made to W. T. Thomson, assistant professor in the department of applied mechanics in the Kansas State College, in recognition of a paper entitled "A Method of Mea-

suring the Thermal Diffusivity and Conductivity of Stone and Concrete."

THE James R. Jewett and Vieno Johnson prizes of \$100 and \$50, respectively, have been awarded by the Arnold Arboretum of Harvard University to Mrs. Wilfred O. White, of Boston and Vineyard Haven, Mass., and to Mrs. Ina Snow, of Truro, Mass., in appreciation of their interest in developing the utilization of the native beach plum, *Prunus maritima*. These prizes, made possible through the interest of Professor James R. Jewett, of Harvard University, are to be awarded annually to individuals who have made significant contributions to the improvement of the beach plum and other native fruit plants. This is the first award.

THE Melchett Medal of the British Institute of Fuels for 1941 has been awarded to Dr. Clarence A. Seyler, of Swansea, in recognition of his work on coal and its constitution. W. M. Selvey has been elected president of the institute to succeed Sir John Greenly.

FREDERICK OSBORN, research associate in anthropology at the American Museum of Natural History, has been nominated by President Roosevelt to be brigadier-general in command of the morale branch of the Army. He succeeds Brigadier-General James A. Ulio.

*Nature* reports that the sixty-seventh annual general meeting of the Physical Society, London, was held on July 25 with Professor Allan Ferguson in the chair. The reports of the council and of the treasurer were adopted and the following officers for

1941-42 elected. *President*: Dr. C. G. Darwin; *Honorary Treasurer*: Dr. C. C. Paterson; *Honorary Secretary (Business)*: Dr. W. Jevons; *Honorary Secretary (Papers)*: J. H. Awbery; *Honorary Librarian*: Dr. L. C. Martin; *New Members of Council*: Professor E. N. da C. Andrade and Dr. H. Shaw. Professor Ferguson will undertake the duty of acting-president until Dr. Darwin is able to take office. The council has to record a very successful year's work in difficult circumstances. Despite exceptionally heavy losses by death, the membership of the society is scarcely affected, standing at 1,070 members at the end of 1940, as compared with 1,084 members twelve months earlier.

PROMOTIONS to professorships at the University of Michigan include Dr. Dean B. McLaughlin and Dr. Will Carl Rufus, astronomy; Russell A. Dodge, engineering mechanics; John M. Nickelsen, mechanical engineering; Walter C. Sadler, civil engineering, and Dr. Henry Field, Jr., internal medicine.

DR. HARRY L. ALEXANDER, associate professor of clinical medicine at the School of Medicine of Washington University, St. Louis, has been made professor of clinical medicine and acting head of the department of internal medicine. He succeeds Dr. David P. Barr, who resigned to accept an appointment at the Cornell University Medical College, New York City.

DR. F. D. HEALD, professor in charge of the work in plant pathology at the State College of Washington since 1915, will retire with the title of emeritus on September 1 as head of the department of plant pathology of the college and head of the division of plant pathology in the Agricultural Experiment Station. He will continue his work in teaching and in research. Dr. Heald will be succeeded as head of the department and division by Dr. J. G. Harrar, associate professor of plant pathology and botany at the Virginia Polytechnic Institute.

DR. FRED F. MCKENZIE, of the University of Missouri, has been appointed head of the department of animal husbandry of the Utah State Agricultural College. Dr. McKenzie succeeds Dr. Ralph W. Phillips, who resigned to accept a position with the Federal Bureau of Animal Industry at Beltsville, Md., where he will have charge of animal genetics research for the bureau. Since the early part of May Dr. McKenzie has been in South America under the auspices of the Federal Department of State. His specific assignment has been to assist the Governments of Chili and Peru with their sheep-breeding problems at high altitudes, where considerable difficulty has been experienced in the fertility of the breeding stock. In Utah one of his chief responsibilities will be that of supervising a

program of research dealing with range livestock breeding and nutrition.

DR. EDGAR J. BOELL has been promoted from assistant to associate professor of biology at Yale University.

DR. EARL L. GREEN, post-doctoral fellow at the University of Chicago, has been appointed instructor in zoology at the Ohio State University, where he will teach genetics and biometry.

DR. O. C. STEWART has been appointed instructor in anthropology at the University of Minnesota.

DR. J. L. OTIS, professor of industrial psychology, and Dr. Oliver H. Ohmann, head of the department of psychology, will direct a Personnel Research Institute, which has been established in Cleveland College, the downtown department of Western Reserve University. The institute was made possible by an appropriation by the Thomas H. White Fund and by the aid of business firms and institutions.

DR. ENRIQUE WASHINGTON LITHGOW, of Ciudad Trujillo, head of the laboratory service at the Padre Billini Hospital of the Dominican Republic, will receive the fellowship founded in 1937 of the Dazian Foundation for Medical Research at Mount Sinai Hospital, New York City. He is on leave of absence and expects to return after spending a year in New York.

LORD HORDER has been appointed personal adviser to the British Minister of Food.

ACCORDING to the London *Times*, a certificate presented to the British Parliament by the Prime Minister enables Professor A. V. Hill, one of the members for the University of Cambridge who has become an associate member of the Ordnance Board appointed by the Minister of Supply, to retain his seat in the Commons.

FIELD MUSEUM OF NATURAL HISTORY is collaborating with the Institute of Andean Research, New York, in an archeological expedition to Ecuador. Donald Collier, recently appointed assistant curator of ethnology at the museum, has left Chicago and planned to sail from New York on August 29 to spend five months supervising archeological investigations for the institute. The project is sponsored by the coordinator of commercial and cultural relations of the American Republics.

DR. RAYMOND L. DITMARS, curator of reptiles and insects at the New York Zoological Park, sailed on August 19 for Trinidad to make a collection of vampire bats, stingless scorpions, giant cave crickets and cave roaches for a vampire bat cave to be opened at the park in October. The cave will be a reproduction

of a dimly lighted gallery in one of the Trinidad bat caves.

THE Biological Photographic Association, an international group of photographers in the natural sciences, will hold its eleventh annual meeting in the Hotel Buffalo, Buffalo, New York, on September 11, 12 and 13.

THE *London Times*, quoting from the *Soviet War News*, issued by the Soviet Embassy in London, states that the Royal Society sent on July 25 a message to the Academy of Sciences of U.S.S.R., Moscow, which reads: "Our united efforts will ensure that the future of science is not endangered by the destruction of those freedoms in which has thrived the work of the great scientists of both countries. In this struggle science has already made, and will continue to make, essential contributions to victory."

ACCORDING to *Nature*, the secretary of the Marine Biological Association reports that the Plymouth Laboratory, which a few months ago sustained heavy damage through enemy action, has now been restored to working order. Extensive emergency repairs have been carried out, accommodation for research workers is once more available and there are limited opportunities for work at sea in the motor boat of the association. It has, however, been necessary to transfer the greater part of the library to other quarters, and only recent volumes of current periodicals can now be consulted.

A UNITED PRESS dispatch from Berlin reports that there has been established in Germany an institute for vitamin testing and research "for the treatment of questions arising regarding the vitamin supply of the German people, and for the guidance of the government in measures to be taken." The institute will be directed by the Ministries of the Interior and Food.

THE New York City Board of Estimate has authorized an appropriation of \$375,000 as the initial cost of construction of the Nightingale Hospital for the treatment of cancer, which will be built at 163d Street and Fort Washington Avenue. The land is being given by the Columbia-Presbyterian Medical Center, which is adjacent, and the hospital will be conducted by the Department of Hospitals in conjunction with the College of Physicians and Surgeons of Columbia University, a part of the Medical Center.

*The News Edition* of the American Chemical Society reports that a three-story laboratory and office building has been completed at the Experimental Station of E. I. du Pont de Nemours and Company, Inc., Wilmington, Del. This replaces a smaller structure in which the laboratories have been housed since 1937, devoted to pest control research. The laboratory affords the most modern equipment for the study of insecticides and fungicides. A carbon-arc lamp, said

to be the closest approach to natural sunlight yet devised, has been installed in the adjacent greenhouse. The lamp gages the effects of sunlight on insecticides and fungicides on growing plants. An experimental garden plot that is used for preliminary testing of pesticides on plants adjoins the greenhouse. The new unit has been designed to permit the closest possible coordination of experimental and practical work, according to Wendell H. Tisdale, director. Extensive field trips are conducted under different regional conditions throughout the country. In addition to the usual problems of insect control, investigations at the laboratory include development of non-poisonous fungicides for use on stored agricultural products, such as fruits and vegetables; wood preservation for the control of stains, fungus decay and termites and for the treatment of cellulosic materials; preservation of harvested plant products, weed extermination and a study of plant hormones.

AN Institute of Gas Technology has been established at the Illinois Institute of Technology. The sum of \$100,000 per year for ten years will be provided for operating and maintenance expenses which will include the cost of instruction. Additional funds will be available for erection of buildings to house teaching and research activities. It is planned to open the institute at the beginning of the academic year in September. From five to ten fellowships will be granted during the first year. Seventeen gas companies are members of the organization group. Administration of the institute will be vested in a board of trustees made up of representatives of the gas industry and of the trustees of the institute.

THE zoological laboratory of Columbia University, under the direction of Professor Leslie C. Dunn, head of the department of zoology, is being enlarged and modernized. Reconstruction, it is expected, will be completed in time for the opening of the academic year. The floor space of the laboratory will be increased by 264 square feet. It will include a cold room for the storage of animal cadavers in which a constant temperature of 45 degrees will eliminate the need for any other form of preservative. The laboratory, which is on the sixth floor of Schermerhorn Hall, will provide permanent desk and cabinet space for forty-eight students instead of the twenty-four previously accommodated. The desks will be arranged in banks of six, each with one alternating and two direct current outlets. A sink with eighteen water faucets will be placed in each bank. A larger concentration of pre-medical students taking courses in embryology, histology and zoology has, in addition to the general deterioration of the original facilities, made necessary the reconstruction of the old laboratory.

## DISCUSSION

THE INTERPRETATION OF EXPERIMENTAL  
FOUR-FOLD TABLES

IN a note printed in *SCIENCE*, June 13, 1941, Dr. E. B. Wilson<sup>1</sup> discusses the discrepancy in the probabilities arrived at by two different methods of treating the four-fold table of experimental results, where groups of animals subjected to two contrasted treatments are recorded as having lived or died. He concludes by saying:

Hence there is neither logical nor arithmetic likelihood that the use of  $\chi^2$  should solve well our problem of determining whether the effects of treatment in experiment and control are statistically significant. It is still true, of course, that if numbers are sufficiently large,  $\chi^2$  will give the correct probabilities, but they have to be larger than is customary in such experiments.

Dr. Wilson is eminent among statisticians, both for his practical acumen and for his logical penetration. There is no one whose opinion I would sooner seek on the usefulness of any methods published in mathematical statistics. Yet in advocating the particular method he chooses for the interpretation of data of this important class he has, I believe, overlooked a difficulty which the approach based on, and giving the exact solution for, the classical view-point of  $\chi^2$  and the four-fold table, was expressly devised to obviate.<sup>2</sup>

Let us consider the simple example first discussed by Wilson. Of six treated mice five have died and one lived, while of six controlled mice one has died and five lived. Wilson considers the probability that the difference between the proportion dying in the two series shall be as great as, or greater than, that observed; that is, in the present instance, the aggregate probability of the six possible experimental results:

	Died	Lived	Total	Died	Lived	Total
(a)				(b)		
Treated	6	0	6	6	0	6
Control	2	4	6	1	5	6
Total	8	4	12	7	5	12
(c)				(d)		
Treated	6	0	6	5	1	6
Control	0	6	6	1	5	6
Total	6	6	12	6	6	12
(e)				(f)		
Treated	5	1	6	4	2	6
Control	0	6	6	0	6	6
Total	5	7	12	4	8	12

in contrast with all the remaining possible results, in which the difference between the numbers dying is not so great as four in favor of the treated series.

<sup>1</sup> E. B. Wilson, *SCIENCE*, 93: 557-560, 1941.

<sup>2</sup> R. A. Fisher, "Statistical Methods for Research Workers" (Section 21.02), Oliver and Boyd, Edinburgh. 1925-1941.

Assuming that the chance of death is one half in each series, the total probability of getting one or other of these six results is 79 out of 4,096, or 1.9287 per cent. The basis of this assumption, which is not likely to be exactly true, is that the total number which died in both series together is just one half of the total under observation.

It is this circumstance which introduces a logical difficulty, for the probability assigned to the chosen group of possible results does not depend only on the results which constitute the group, but on the particular one of them which has been observed. Thus to the possible result (a) in which six of the treated mice die and two of the untreated, the probability  $\frac{15}{4,096}$  or 0.3662 per cent. has been assigned in the calculation made above; but if this particular outcome had been observed a different probability, namely,  $\frac{3840}{531441}$  or 0.7226 per cent. would have been ascribed to it, since the chance of death would be taken to be  $\frac{1}{3}$ . The probabilities arrived at by this method do not, in fact, correspond with any objective frequency distribution applicable to the whole aggregate of possible experimental results. Moreover, the probabilities assigned to each particular result, if it were observed, would not add up to unity.

The method which Wilson speaks of as the use of  $\chi^2$ , and which, though it is an exact arithmetical method, in which the  $\chi^2$  distribution is not employed, did arise from the study of the inadequacy of  $\chi^2$  when used with small numbers, proceeds on a different plan; from the aggregate of all possible results of the experiment we select those, seven in number, which have the same marginal totals. These are:

	Died	Lived	Total	Died	Lived	Total
A				B		
Treated	6	0	6	5	1	6
Control	0	6	6	1	5	6
Total	6	6	12	6	6	12
C				D		
Treated	4	2	6	3	3	6
Control	2	4	6	3	3	6
Total	6	6	12	6	6	12
E				F		
Treated	2	4	6	1	5	6
Control	4	2	6	5	1	6
Total	6	6	12	6	6	12
G						
Treated	0	6	6			
Control	6	0	6			
Total	6	6	12			

Now it may be shown by simple algebra that *whatever is the probability of dying*, supposing this to be the same for the treated and the controlled series, the

relative frequencies with which these seven results will occur are the same, namely, out of 924 trials for which one or other of these seven observations is made, we may expect:

Result	A	B	C	D	E	F	G
Frequency	1	36	225	400	225	36	1

The possible results arrange themselves without ambiguity in order such that A is most favorable and G least favorable to the view that the treatment has increased the probability of death. The sum of the probabilities of the outcome observed and of the one more favorable possibility is  $\frac{37}{924}$  or 4.0043 per cent.

We should, therefore, judge the result significant in favor of the view that treatment had increased the death rate, though not nearly so strongly significant as if we had relied on the first method of calculation.

Using the second method, it should be noted that the particular experimental result arrived at (B) determines without ambiguity both the series of results having the same marginal totals, with which its probability is to be compared, and its ordinal position in this series. Had any other observation within the same series been made, (B) would have been assigned the same probability, the sum of the probabilities of the members of each series being always unity.

The danger of using the double binomial is very clearly brought out by Wilson's comparison, for with small numbers the probability assigned is often no more than one third or one half of that given by my method. This is no doubt due to the method assuming some plausible value for the death rate among the controls *as known to be true*, an assumption which would be justified only if the number of animals used as control were increased indefinitely. If, for example, we knew this death rate to be one in six, the probability of observing so many as five dead among the treated series, having *ex hypothesi* the same death rate, would be only  $\frac{31}{46656}$  or .0664 per cent. Our ignorance of the true death rate is, however, an essential part of the logical position, and is indeed the only reason why the control series is observed at all.

R. A. FISHER

THE GALTON LABORATORY

### ELECTRICAL ACTIVITY OF ACETYLCHOLINE

ACETYLCHOLINE is produced by activity of the nervous system and has a stimulating action on ganglia and muscles, but the relation between acetylcholine and electrical phenomena in nerve is still obscure. Previous work<sup>1</sup> has shown that alkaloidal salts

can produce electrical negativity when in contact with oil or lipoids. Moreover, it has been demonstrated<sup>2</sup> that acetylcholine modifies the electrical potential of skin in a negative direction. These findings led to the present experiments which show the production of a negative electrical potential by contact of an extremely dilute acetylcholine solution with various water-insoluble substances resembling lipoids.

In this model of electrical phenomena in nerve the oil layer (guaiacol, nitrobenzene, cresol, creosote or other substances) made contact on each side with 0.7 per cent. NaCl connected by salt bridges to beakers containing 0.7 per cent. NaCl into which dipped Ag-AgCl<sub>2</sub> electrodes leading to the E.M.F. terminals of a Leeds and Northrup thermionic amplifier (for high resistance circuits) serving as a null instrument for a potentiometer. In some experiments the surface of the oil to be treated made contact with 0.1 per cent. sodium benzoate which established a positive charge, thereby increasing the sensitivity of the layer to the negativity of acetylcholine. Meecholy (acetyl-beta-methylcholine), acetylcholine chloride and acetylcholine bromide produced negative potentials which were proportional to the logarithm of the concentration. The highest potential obtained was 200 mv. with 0.03 per cent. meecholy and nitrobenzene in saline. The lowest effective concentration obtained so far was one in one hundred million parts of acetylcholine chloride, which gave rise to 5 mv. (negative) on nitrobenzene in 0.1 per cent. sodium benzoate. Experiments now in progress indicate that the threshold is considerably lower than this concentration and may approach the value of  $5 \times 10^{-6}$  micrograms which Buchthal and Lindhard<sup>3</sup> reported as the threshold concentration for stimulation of the end plate by acetylcholine introduced by a micromanipulator.

The electrical negativity following acetylcholine, compared with other alkaloids,<sup>1</sup> is remarkable for its size, its rapidity of appearance on application and disappearance after removal and for the extremely low concentrations required. These observations may support the hypothesis that perhaps acetylcholine produces a part of the negative electrical variation in nerve. Moreover, deNo<sup>4</sup> has found that acetylcholine is liberated from nerve fibers as well as from synapses and Boell and Nachmansohn<sup>5</sup> have recently reported that choline esterase is concentrated along the surface of the axon. Regardless of the theory of the nervous impulse adopted, we wish to draw attention to the pro-

<sup>2</sup> T. C. Barnes, *Amer. Jour. Physiol.*, 130: 557, 1940.

<sup>3</sup> F. Buchthal and J. Lindhard, *Jour. Physiol.*, 95: 59P, 1939.

<sup>4</sup> R. L. deNo, *SCIENCE*, 91: 501, 1940.

<sup>5</sup> E. J. Boell and D. Nachmansohn, *SCIENCE*, 92: 513, 1940.

<sup>1</sup> R. Beutner, *Jour. Am. Chem. Soc.*, 36: 2045, 1914; *Jour. Pharm. Exptl. Therap.*, 31: 305, 1927.

nounced electromotive activity of acetylcholine. No other substance in such diminutive concentrations is known to produce perceptible electromotive effects on second-class conductors.

R. BEUTNER

T. CUNLIFFE BARNES

DEPARTMENT OF PHARMACOLOGY,  
HAHNEMANN MEDICAL COLLEGE AND  
HOSPITAL OF PHILADELPHIA

#### THE DETERMINATION OF THIAMIN BY THE YEAST FERMENTATION METHOD

A RECENT note in SCIENCE by H. H. Bunzell<sup>1</sup> described experiments on yeast fermentation in which only an 8 per cent. stimulation of fermentation rate was caused by thiamin, whereas a 106 per cent. stimulation was produced by an extract of wheat germ. Observations such as these naturally cast doubt upon the reliability of the yeast fermentation method for the determination of thiamin.<sup>2,3</sup> In view of the widespread use of the latter method it was considered desirable to show how Bunzell's experiments differ from the published procedure.<sup>3</sup>

His description of the fermentation medium mentions a "nutrient" solution. This term does not occur in our paper,<sup>3</sup> and thus there is no way of knowing exactly what his "nutrient" solution contained. However, on the basis of our experience with fermentation it is probable that his "nutrient" solution *did not contain ammonium ions* as required by the published procedure.<sup>3</sup>

Without ammonia in the medium thiamin causes a very slight stimulation and, conversely, without thiamin ammonia causes only a slight stimulation. The combination of the two in maximum amounts, however, causes a 100 per cent. increase in fermentation rate. This circumstance might explain Bunzell's results with the wheat germ extract since it has been shown<sup>4</sup> that various amino acids, etc., have an effect equivalent to ammonium ions.

Bunzell's difficulties recall the experience of Smythe,<sup>5</sup> who, observing a remarkable stimulation of fermentation due to an extract of bull testicle, finally isolated ammonium chloride as the active factor. Smythe made the additional mistake of obtaining his yeast from the small cakes sold in grocery stores. Such yeast is too rich in thiamin to show any stimulation of fermentation when thiamin is added to the medium.

<sup>1</sup> H. H. Bunzell, SCIENCE, 93: 238, 1941.

<sup>2</sup> A. S. Schultz, Lawrence Atkin and C. N. Frey, *Jour. Am. Chem. Soc.*, 59: 2457, 1937.

<sup>3</sup> Lawrence Atkin, A. S. Schultz and C. N. Frey, *Jour. Biol. Chem.*, 129: 471, 1939.

<sup>4</sup> A. S. Schultz, L. Atkin and C. N. Frey, *Cereal Chem.*, 16: 648, 1939.

<sup>5</sup> C. V. Smythe, *Enzymologia*, 6: 9, 1939.

If the published procedure for the determination of thiamin<sup>3</sup> is followed with ordinary attention to detail, a satisfactory determination of the thiamin content of wheat germ will be obtained.

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#### CONTROL OF RED SPIDER (TETRANYCHUS TELARIUS) BY PHTHALIC GLYCERYL ALKYD RESIN

THE common red spider (*Tetranychus telarius* L.), commonly found on greenhouse-grown plants and on many field crops, is extremely difficult to control. The ineffectiveness of many insecticides which have been recommended for control of red spiders may be ascribed to their lack of ovicidal action. Furthermore, chemicals which possess ovicidal properties are often injurious to cultivated plants, especially those grown in greenhouses.

In the course of an investigation, totally unrelated to the problem of red spider control, the writers observed that when a 2 per cent. phthalic glyceryl alkyd resin in water was applied to plants heavily infested with red spiders, the latter quickly disappeared. Microscopic examination of infested leaves showed large numbers of dead red spiders in all stages of development and masses of spiders' ova which had turned yellow and become shriveled after five days. Further examination of the ovicidal properties of phthalic glyceryl alkyd resin showed that it possesses a remarkable insecticidal efficiency. No injury was observed on plants tested experimentally under greenhouse and field conditions. Concentrations less than 2 per cent. (but not less than 1 per cent.) were effective on adults but not on ova; above 2 per cent. the margins of the leaves were burned.

The following plants were sprayed with beneficial results and without injury to the leaves: alfalfa (*Medicago sativa* L.), almond (*Prunus communis* Fritsch. and *P. nana* Stokes), apple (*Pyrus malus* L.), apricot (*Prunus armeniaca* L. and *P. mume* Sieb. & Zucc.), begonia (*Begonia octapetala* L'Her., *B. tuberhybrida* Voss., *B. semperflorens* Link and Otto, *B. haageana* Wats., and *B. rex* Putz.), *Coleus blumei* Benth., florists cyclamen (*Cyclamen indicum* L.), *Gardenia veitchii* Bailey, *Pelargonium* sp., grape (*Vitis vinifera* L.), *Hydrangea hortensis* Smith, India rubber plant (*Ficus elastica* Roxb.), ivy (*Hedera helix* L.), poinsettia (*Euphorbia pulcherrima* Willd.), plum (*Prunus americana* Marsh), rose (*Rosa* sp.), snapdragon (*Antirrhinum majus* L.), strawberry (*Fra-*

*garia* sp.), and tomato (*Lycopersicum esculentum* Mill. var. *vulgare* Bailey).

An unidentified species of a very minute, white mite occurring on ivy and China asters (*Callistephus chinensis* Nees) and a begonia mite (probably *Avrosia translucens* Nietner) were also successfully controlled by a single application of 2 per cent. solution of phthalic glyceryl alkyl resin.

Since these experiments for the control of red spiders were performed also in commercial greenhouses and in the field, it seems highly probable that this chemical may find a wide application. Additional advantages which it possesses include no disagreeable odor, lack of spray residue on the leaves, its high degree of spreading capacity and only one application is necessary for killing the adults and the ova.

P. A. ARK

C. M. TOMPKINS

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### A BIRD LIST

IN SCIENCE, for July 18, you refer to a bird list,

made by Roger Peterson and myself (not my brother, Dr. Frederick H.) at the Fairchild Connecticut Gardens, on May 18, as a "bird census."

To my mind, it was in no sense a census, but simply a more or less superficial list of the species of birds noted during the course of a morning's walk through the area. The word "census" has been widely misused in this way in the past, and it would seem highly desirable to arrive at some general agreement as to what constitutes a "bird census."

If we adhere strictly to the dictionary definition of the word "census," a true bird census of a 127½-acre tract, swarming with migrants on the move, in addition to the resident species, would be almost impossible to take on a May morning. In view of the increasing need in ecological work for real censuses of the numbers and kinds of wild animals occurring on sample areas—it would seem wise to call any record, which does not represent a conscientious effort to record every single individual bird in the area at the time, a "bird count" or "bird list."

RICHARD H. POUGH

## SCIENTIFIC BOOKS

### ZOOLOGY

*A Text Book of Zoology.* By the late T. JEFFERY PARKER, D.Sc., F.R.S., and the late WILLIAM A. HASWELL, M.A., D.Sc., F.R.S. Sixth Edition, in two volumes, Volume II revised by C. Forster-Cooper, M.A., Sc.D., F.R.S. xxiii + 758 pp.; 1-656 figs. 8vo. London: Macmillan and Co., Limited.

THIS famous text-book of zoology was originally a descriptive reference work of monumental character; it stemmed from the heroic period of T. H. Huxley, W. K. Parker and W. H. Flower but was not completed and published until 1898. Although both the volumes emphasized the factual side of development and morphology, the first volume, on the invertebrates, contained far more and better treatment of major phylogenetic problems than the second, which was for the most part merely an orderly record of bare facts with a minimum of inference. But these facts were so conveniently set forth that the rising demand has kept the work going through six editions.

In the first five editions some new details were added, but few radical changes were made and there was scant notice of the huge expansion of knowledge that had meanwhile taken place in the fields of vertebrate paleontology and general morphology. At last, however, the time came when it was realized that Parker and Haswell, Volume II, was in great need of modernization, and this formidable undertaking was then fortunately entrusted to C. Forster-Cooper, M.A.,

Sc.D., F.R.S., late director of the University Museum of Zoology at Cambridge and for some years director of the British Museum (Natural History).

The theme of the volume is the "Phylum Chordata," treated strictly from a taxonomic-anatomical viewpoint. In order to compress this enormous subject into practicable limits, the reviser has ignored many such significant techniques as the mathematical treatment of growth and form and the illimitable fields of genetics, physiology and the like; albeit that in many universities these are considered to be the central themes of modern zoology. But these subjects are already well represented by excellent contemporary text-books; whereas Parker and Haswell, Volume II, while still without a peer in its own territory, was getting to be so far behind the times that it might have been abandoned entirely in favor of a wholly new work. Thanks to the reviser and his collaborators, however, the old book has now been thoroughly rejuvenated or, more accurately, revised and enlarged. In its handsome new format we might even liken it to some stately building to which new extensions have been added but in such a way as to increase the usefulness of the parts and enhance the general effect of the whole.

The old text aimed to describe accurately the resemblances and differences between the innumerable products of vertebrate evolution; it but rarely referred to the changes in anatomical structure whereby one type has been transformed into another. The result

was a static picture of vast scope and intricacy, catalogued systematically and described with the aid of a countless multitude of technical terms. As clues to this labyrinth there were and are an excellent classification of the chordates in the table of contents and a most full and useful index, the latter now filling fifty-seven pages of three columns each. But though these and similar features still make the book invaluable as a reference work, they must at the same time have contributed to the sense of continued frustration, especially to those students who persisted in asking such questions as: "By what steps did this particular anatomical complex attain its present state?" or, "Through what successive grades and branches did this animal evolve?"

The best of the additions to the old text are those in which the reviser and his nearer colleagues and friends have themselves made major contributions: especially in the sections dealing with the paleozoic ostracoderms, placoderms and fishes, the earlier amphibians, the origin and adaptive branching of the main divisions of the reptiles, the rise of the mammal-like reptiles and the diverse evolution of the ungulate mammals. These were all very inadequately treated in earlier editions but are now concisely set forth with the aid of many new figures, diagrams and charts; all of which fairly shine forth from the ample pages. In the newer parts of the work the reviser aims to outline the history of each major group in so far as it can be reliably reconstructed from paleontologic evidence and to indicate its probable relationships with other larger groups. This is most admirably done for the perissodactyls and some other groups of ungulates among the mammals and in varying degrees for other vertebrates.

From a work that already gives so much it may seem unreasonable to ask for more; but we hope that in the next edition the reviser may preface the general chapter on chordate morphology with a critical review of the principal theories of the origin of the vertebrates. It may then be noted that theories involving the transposition of the primary invertebrate nerve cord from the functionally ventral to the functionally dorsal surface are based on similar but apparently convergent adaptations to forward locomotion in bilateral animals of widely different phyla, as between *Limulus* of the Arthropoda and *Cephalaspis* of the Vertebrata. And it seems further that the factual material might have gained added significance if it had been suggested that the typical piscine chordate is essentially a swift-moving predaceous fish, which is already far advanced beyond the stage of the earliest known chordates. These were the Ordovician, Silurian and Devonian ostracoderms, which were relatively slow-moving, partly bottom-feeding forms, whose head and thorax

were covered with a stiff dermal armor somewhat like dentine. Although these are well described and figured in the present work, it might have been noted that the studies of Stensiö, Heintz and Kiaer have led them to infer that the more or less continuous thoracic armor later broke down into the more flexible armor of such relatively swift-moving forms as the anaspids.

The present edition adopts the conservative view that the ostracoderms as a whole were an early side branch of the vertebrate stock, ancestral to the existing lampreys and hagfishes but definitely not ancestral to the true jaw-bearing or gnathostome branch of the vertebrates. While this may well be true of almost any given ostracoderm, it seems to the present reviewer far more likely that the general characters of the ostracoderms are truly primitive and that the jaw-bearing vertebrates in adopting predatory habits arose by greatly enlarging the branchial pouches, which are already present in the ostracoderms, and by emancipating the gill bars from the chondrocranium and modifying the anterior ones into jaws, according to the stages recently suggested by Romer (1937). And in like manner, the placoderm stock, although giving rise to many side branches, seems in its basal characters to be structurally intermediate between the officially "jawless" ostracoderms and the typical gnathostomes.

In general the reviser seems to follow the current practice of assuming that the possession of any conspicuous specialization, such as the slightly movable joint across the skull roof of the Devonian rhipidistian fishes, debars its possessor from being ancestral to later forms which do not have this specialization. The reviewer, however, has seen many such cases in which it seems that earlier specializations become overshadowed by later ones and fade out of the hereditary pattern. However this may eventually prove to be, it seems safe to predict that in the publication of the sixth edition the second volume of Parker and Haswell enters upon a new and far wider career of popularity among advanced students and teachers of vertebrate zoology.

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### SYMBOLIC LOGIC

*Introduction to Logic* (and to the methodology of deductive sciences). By ALFRED TARSKI. Enlarged and Revised Edition. New York: Oxford University Press. 1941. \$2.75.

THE last thirty years have witnessed a rapid and intense development of the symbolic study of logic and of its profound applications in mathematics, in

philosophy and in other disciplines depending on deductive thinking. Some of this development has been difficult for outsiders to follow, both because of the precision of the analysis used, and because of the complexity of the symbolic formulations necessary. There has long been a need for a clear-cut introduction to the new logic, which would state in an elementary but precise language the fundamental problems studied, and which would at the same time be free from an undue dependence upon traditional logic or upon special and controversial doctrines. The need has now been admirably met by this book, written by a distinguished Polish mathematician and logician who is widely known for his own fundamental contributions to logic.

Tarski's book begins with an elementary discussion of the notion of a variable and of the sentential calculus, which treats the properties of the basic logical connectives "and," "or," "not" and "implies"; subsequent chapters deal with the properties of identity, with the analysis of classes and with the calculus of relations. The chapter on axiomatic methods gives a careful elucidation of such fundamental concepts as the completeness and the consistency of a formalized deductive theory. It includes a discussion of some of Tarski's own recent results on the completeness of the ordinary system of Euclidean geometry. Roughly speaking, these results mean that every problem of *elementary* high-school geometry can be resolved by using the

ordinary procedures in a systematic manner. The second part of Tarski's book illustrates the previously developed concepts of logic and methodology by setting up two equivalent systems of axioms for the real numbers. These are the axioms which lie at the basis of calculus and higher mathematical analysis.

Throughout the book the symbolism is held to a minimum. The explanations are admirably clear and objective. The book itself is a considerably enlarged and improved version of a monograph previously published both in Polish and in German; the translation has been done by Olaf Helmer. This English edition contains much new material: many new and well-chosen exercises, some with hints and suggestions of further problems; some apt historical notes on the essential contributions of various logicians; a good critical bibliography; some eminently fair discussions of controversial issues, such as the distinction between the use and the mention of an expression and the divergent claims for "strict" and "material" implication. (On page 182 there is a disturbing misprint. In the second italicized statement,  $z : x$  should be replaced by  $z \cdot x$ .) All in all, this book is to be heartily recommended, both to the interested scientist who would like to discover what this logic business is all about and to the teacher searching for a dependable and accurate text for college courses in logic.

SAUNDERS MACLANE

HARVARD UNIVERSITY

## REPORTS

### THE ELLA SACHS PLOTZ FOUNDATION FOR THE ADVANCEMENT OF SCIENTIFIC INVESTIGATION

DURING the seventeenth year of the Ella Sachs Plotz Foundation for the Advancement of Scientific Investigation, eighty-one applications for grants were received by the trustees, fifty-one of which came from the United States, the other thirty coming from fifteen different countries in Europe, Asia, North and South America. The total number of grants made during this year was twenty-three, one of these being a continued annual grant.

In the seventeen years of its existence the foundation has made three hundred and ninety-four grants which have been distributed to investigators in Arabia, Argentina, Austria, Belgium, Brazil, Canada, Chile, China, Czechoslovakia, Denmark, Egypt, Estonia, Finland, France, Germany, Great Britain, Greece, Hungary, India, Iraq, Italy, Latvia, Lebanon, Netherlands, North Africa, Norway, Palestine, Poland, Portugal, Roumania, South Africa, Sweden, Switzerland, Syria, Venezuela, Yugoslavia and the United States.

The list of the investigators and the purposes of the research aided in the current year is as follows:

Professor William H. Adolph, Peiping, China, studies in calcium and oxalate metabolism.

Dr. Kenneth T. Bainbridge, Harvard University, biological research with radioactive isotopes.

Dr. Georg Barkan, Boston University School of Medicine, investigations in the field of hemoglobin determinations.

Dr. E. L. Borkon, Southern Illinois State Normal University, Carbondale, study of the compensatory hypertrophy occurring in a remaining kidney in hypothyroid, normal and hyperthyroid albino rats.

Dr. Siegbert Bornstein, Beth Israel Hospital, New York, continuation of investigations on the chemical constitution of the antigens within the Salmonella group.

Dr. Austin M. Brues, Collis P. Huntington Memorial Hospital, Boston, studies on regulation of growth in tissue cultures.

Professor D. R. Drury, University of Southern California School of Medicine, Los Angeles, continuation of work on the kidney and hypertension.

Professor Herbert Elias, New York Medical College, study of the influence of various ductless glands on the threshold of the kidney.

Dr. George Fahr, University of Minnesota Medical School, investigation of the effect of strophantoxid K upon the heart failure produced by chloroform, potassium ion and chloral hydrate; and investigation of the effect of narrowing the circumflex branch and the descending branch of the left coronary artery upon cardiac hypertrophy.

Dr. Allan L. Grafflin, Harvard Medical School, analysis of functions of living organs *in situ*, study of frozen sections, tissue spreads, blood smears, etc., with and without the addition of fluorescent compounds.

Dr. David E. Green, Harvard Medical School, work on the isolation of enzymes.

Dr. F. B. Gordon, University of Chicago, search for an etiological agent in rheumatic fever by means of inoculation of fetal animals and by culture.

Dr. Irvin M. Korr, New York University, research on the relation between tissue metabolism and physiological activity.

Dr. Fritz Lipman, Cornell University Medical College, New York, continuation of work on pyruvic acid oxidation.

Dr. Romano H. de Meio, Rosario, Argentina, South America, work on the action of sympathomimetic drugs on tissue respiration.

Dr. Ernst P. Pick, New York, investigation of brain tissue *in vitro*.

Dr. J. P. Quigley, Western Reserve University School of Medicine, Cleveland, study of the process of gastric evacuation.

Dr. George J. Scheff, New Haven, study of fluorescence.

Dr. A. K. Solomon, Harvard University, biological studies making use of artificial radioactive tracers.

Professor Barnett Sure, University of Arkansas College of Agriculture, Fayetteville, continuation of research on the vitamin C phase of the hyperthyroid problem.

Thorndike Memorial Laboratory, Boston City Hospital (Professor George R. Minot, Director), in recognition of Dr. Francis W. Peabody's services to the foundation.

Professor Charles W. Turner, University of Missouri College of Agriculture, Columbia, research on the endocrinology of lactation.

Dr. Earl Walker, University of Chicago, investigation of the eye movements elicitable from electrical stimulation on the striate, para- and peristriate cortex of the macaque monkey.

In their first statement regarding the purposes for

which the Fund would be used, the trustees expressed themselves as follows:

For the present, researches will be favored that are directed towards the solution of problems in medicine and surgery or in the branches of science bearing on medicine and surgery.

As a rule, preference will be given to researches on a single problem or on closely allied problems; it is hoped that investigators in this and in other countries may be found, whose work on similar or related problems may be assisted so that more rapid progress may be made possible.

Grants may be used for the purchase of apparatus and supplies that are needed for special investigations and for the payment of unusual expenses incident to such investigations, including technical assistance, but not for providing apparatus or materials which are ordinarily a part of laboratory equipment. Stipends for the support of investigators will be granted only under exceptional circumstances.

In the past few years the policy outlined in paragraph 2 has been neglected. During the present great need for funds, grants will be given in the sciences closely related to medicine without reference to special fields. The maximum size of grants will usually be less than \$500.

Members of the executive committee are: Drs. George B. Wislocki, *chairman*; A. Baird Hastings, Harry Plotz, Bernard Sachs, Paul J. Sachs, Soma Weiss, Joseph C. Aub, *Secretary*.

Applications for grants must state definitely the qualifications of the investigator, an accurate description of the research, the size of the grant requested and the specific use of the money to be expended. In their requests for aid, applicants should state whether or not they have approached other foundations for financial assistance. It is highly desirable to include letters of recommendation from the directors of the departments in which the work is to be done. Only applications complying with the above conditions will be considered.

Applications should be sent to Dr. Joseph C. Aub, Collis P. Huntington Memorial Hospital, 695 Huntington Avenue, Boston, Massachusetts, U. S. A.

## SPECIAL ARTICLES

### THE PREVENTION BY ALPHA-TOCOPHEROL OF "COD LIVER OIL MUSCULAR DYSTROPHY" IN THE RABBIT<sup>1</sup>

THE injurious effect of cod liver oil in the herbivora has been demonstrated by the extensive investigations of Madsen, McCay and Maynard,<sup>2</sup> and Davis, May-

<sup>1</sup> Supported by grants from the Research Corporation of New York and the Carnegie Institution of Washington.

<sup>2</sup> L. L. Madsen, C. M. McCay and L. A. Maynard,

nard and McCay.<sup>3</sup> Lesions of the skeletal muscles were observed in rabbits, guinea pigs, goats and sheep fed cod liver oil. The possible role of vitamin E was discussed, but no definite conclusion was reached.

Memoir 178 of the Cornell University Agricultural Experiment Station, 1935.

<sup>3</sup> G. Davis, L. A. Maynard and C. M. McCay, Memoir 217 of the Cornell University Agricultural Experiment Station, 1938.

We have demonstrated<sup>4</sup> the antidystrophic action of d,l-alpha-tocopherol (synthetic vitamin E) in rabbits fed a diet containing lard and cod liver oil, and have emphasized the fact that the absence of physical symptoms does not exclude extensive microscopic muscle lesions.<sup>5</sup> Recently we have reported<sup>6</sup> that acute muscular dystrophy could be produced in the absence of cod liver oil or other animal fats in rabbits reared on a synthetic diet. The oral administration of 3 mg of alpha-tocopherol 6 days a week to rabbits on this diet afforded complete protection against muscle lesions. The preventive action of the vitamin E was counteracted by the oral administration of 1 cc of cod liver oil soon after the vitamin E.

In more recent experiments employing the same synthetic diet, we attempted to prevent the action of cod liver oil by administering 6 mg of alpha-tocopherol<sup>7</sup> orally on Mondays, Wednesdays and Fridays, and 2 cc of cod liver oil on Tuesdays, Thursdays and Saturdays. This procedure was employed by Shimotori, Emerson and Evans<sup>8</sup> in preventing dystrophy in guinea pigs on a synthetic diet. The rabbits supplemented in this manner developed lesions of the skeletal muscles equaling in severity those produced when the same levels of alpha-tocopherol and cod liver oil were administered within a few minutes of each other, three times a week. In both cases the lesions were frequently not accompanied by overt symptoms.

However, when the dosage of alpha-tocopherol was increased to 40 mg every other day, the administration of 2 cc of cod liver oil on alternate days was without effect. No microscopic lesions were detected in the skeletal muscles. Thus it is clear that alpha-tocopherol when administered in sufficient amounts and under the conditions described protects the rabbit against muscular dystrophy produced by the administration of cod liver oil.

The following propositions have now been demonstrated on rabbits receiving the same basal ration: (1) severe dystrophy develops in rabbits on a vitamin E deficient diet in the absence of cod liver oil; (2) alpha-tocopherol prevents this dystrophy; (3) cod liver oil counteracts the antidystrophic action of alpha-tocopherol and produces muscle lesions, (4) increasing the alpha-tocopherol sufficiently prevents the dystrophic action of cod liver oil. It seems probable that this quantitative relationship also applies to

other species in which cod liver oil produces lesions of the skeletal muscles. A detailed report of these experiments will be published elsewhere.

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JULIA B. MACKENZIE  
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#### THE APPARENT EFFECT OF TYROTHRYCIN ON STREPTOCOCCUS HEMOLYTICUS IN THE RHINOPHARYNX OF CARRIERS

As yet no satisfactory method of eliminating pathogenic bacteria from the rhinopharynx of carriers has been devised. To this end a large number of chemical and physical agents have been unsuccessfully employed. Under the present conditions of shifting industrial populations and mobilization of troops, the problem again becomes urgent.

Dubos's recent isolation of a bactericidal substance from a soil bacillus ("tyrothrycin")<sup>1, 2, 3</sup> suggested that this agent might be effective in clearing the rhinopharynx of certain bacteria such as hemolytic streptococcus, meningococcus, pneumococcus and the diphtheria bacillus.

From cultures of *B. brevis* kindly furnished by Dr. Dubos, "tyrothrycin" was prepared according to the procedure which he has described.<sup>3</sup> The material was found to exert *in vitro* a lethal action on 18-hour broth cultures of hemolytic streptococcus, *staphylococcus aureus* and diphtheria bacillus (gravis strain) in a final dilution of 1:1,000,000, and on recently isolated strains of meningococcus (Type I) in a dilution of 1:100,000. The alcohol soluble fraction diluted 1:100 in normal saline containing 2.5 per cent. glycerine was introduced as a spray into the nose and throat of monkeys (*M. mulatta*) and of man. By means of copious spraying an attempt was made to cover as completely as possible the entire nasopharynx. This was often preceded by preliminary cleaning and shrinking of the mucous membranes. The active agent being insoluble in aqueous solution, vigorous shaking of the suspension was required immediately before use.

Separate nose and throat cultures from human beings were carried out for the demonstration of hemolytic streptococcus according to the method of Mueller.<sup>4</sup>

<sup>1</sup> R. J. Dubos, *Jour. Exp. Med.*, 70: 1, 1939.

<sup>2</sup> R. J. Dubos and R. Hotchkiss, *Jour. Biol. Chem.*, 136: 803, 1940.

<sup>3</sup> R. J. Dubos and R. Hotchkiss, *Jour. Exp. Med.*, 73: 629, 1941.

<sup>4</sup> J. H. Mueller and L. Whitman, *Jour. Bact.*, 21: 219, 1931.

<sup>4</sup> C. G. Mackenzie and E. V. McCollum, *Jour. Nutrition*, 19: 345, 1940.

<sup>5</sup> C. G. Mackenzie, M. D. Levine and E. V. McCollum, *Jour. Nutrition*, 20: 399, 1940.

<sup>6</sup> C. G. Mackenzie, J. B. Mackenzie and E. V. McCollum, *Jour. Nutrition*, 21: 225, 1941.

<sup>7</sup> We are indebted to Merck and Company, Inc., for the supply of alpha-tocopherol.

<sup>8</sup> N. Shimotori, G. A. Emerson and H. M. Evans, *Jour. Nutrition*, 19: 547, 1940.

Preliminary trials in two monkeys which were found to carry in the nasopharynx and throat gram positive hemolytic streptococci and gram negative hemolytic bacilli (*Hemophilus hemolyticus*?) suggested that both these bacterial species disappeared within 2 hours following the administration of tyrothrycin. Cultures taken 5 days after a single treatment revealed no hemolytic colonies in the case of one monkey, whereas in that of the other they appeared only in the throat cultures. Following a second application at this time all cultures were negative within 3 hours. Repeated cultures remained negative for at least 4 days without further treatment. No local or general reactions to the material either in these animals or in a human volunteer were observed.

Accordingly, 5 human carriers of hemolytic streptococcus were treated. Two of them had been persistent nasal carriers for two months following scarlet fever, and 3 were convalescent in the third week of this disease. The results are presented in Table I. Only

given us by Dr. Edwin H. Place and the staff of the South Department of the Boston City Hospital.

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### DEVELOPMENT OF HOMEOTHERMY IN BIRDS

ADULT birds are grouped with mammals as homeothermic or warm-blooded. The development of homeothermy occurs in the early life of the individual and corresponds to the increase in body temperature above that of the environment. This is accomplished through the appearance of special heat-regulating mechanisms presumably located in the base of the brain, in hypothalamus.<sup>1</sup>

Observations show that homeothermy in birds occurs either early or late in the development, depending largely upon the developmental state of the young at

TABLE I  
DATE OF CULTURE

Carrier		6/13	6/14	6/15	6/16	6/17	6/18	6/19	6/20	6/21	6/23
* L	{ N	+++	0	0	0	0	0	0	0	0	0
	{ T	0	S°	0	S 0	S 0	SS# 0	SS# 0	# # 0	0	0
* McD	{ N	nd	nd	nd	++	+	+	0	0	0	0
	{ T	nd	S	nd	S nd	S ++	SS# 0	SS# ±	# # 0	0	0
+ S	{ N	++++	++++	++++	++++	++++	±	++	++	0	0
	{ T	+++	++++	S +++	S +++	S +++	SS# ±	SS# 0	# # 0	0	0
+ McC	{ N	++++	+++	±	++	0	0	0	+	0	0
	{ T	+	+	S +++	S ±	S 0	SS# 0	SS# 0	# # 0	0	0
+ E	{ N	+++	++++	+++	++	+++	±	0	0	+	±
	{ T	0	++	S +++	S ++	S +++	SS# ±	SS# 0	# # +	0	0

\*—Chronic carrier. +—Convalescent scarlet fever patient. ±—1 col. on plate; +—2-5 col. on plate; ++—5-10 col.; +++—many col.; ++++—pure culture with plate hemolysed. nd—Culture not received. S—Spraying. SS—Two sprayings. #—Preliminary cleansing before spray. # #—Spraying stopped at this time. °—Spraying preceded subsequent cultures by 16-24 hours at all times.

in the case of carrier L was an immediate reduction in the number of streptococci obtained. In the others it was not until the fifth day that a striking diminution or disappearance of the organisms occurred, although 3 to 4 sprayings had been administered. This abrupt change on the fifth day we ascribe to the more intensive application of the tyrothrycin begun at that time which seemed warranted by the entire absence of reactions from the smaller orienting doses. These preliminary observations are insufficient to indicate the value of tyrothrycin in the elimination of hemolytic streptococcus from carriers. They are sufficiently encouraging, however, to justify further trial of the material not only against this type of carrier but against others harboring diphtheria bacilli, meningococci and pneumococci. We are now investigating these possibilities.

We gratefully acknowledge the clinical assistance

hatching. With altricial birds (pigeon, pelican), the young of which are naked and helpless for a while, the mechanism for the control of body temperature does not become effective until several days after hatching. Kendeigh and Baldwin<sup>2,3</sup> showed on the house wren that the body temperature of a nestling rises above the external temperature primarily during the fourth to ninth days after hatching. On the other hand, with precocious birds (chick, turkey, pheasant) the young of which are covered with down and soon leave the nest, the mechanism for the control of body temperature becomes effective much earlier, presumably before hatching.

As to the time of the development of homeothermy

<sup>1</sup> S. W. Ranson, *Rev. Publ. Assn. Nerv. Ment. Dis.*, 20: 342-399, 1940.

<sup>2</sup> S. C. Kendeigh and S. P. Baldwin, *Am. Naturalist*, 62: 249-278, 1928.

<sup>3</sup> S. P. Baldwin and S. C. Kendeigh, *Cleveland Mus. Nat. History*, 3: 1-196, 1932.

in the chick, Pembrey *et al.*<sup>4, 5</sup> suggested, on the basis of response in gaseous metabolism to changing temperatures, that it occurs just before hatching. However, the observations of Eycleshymer<sup>6</sup> and Penjonschkewitsch and Rotanow<sup>7</sup> indicate that the temperature of the developing egg begins to rise above the temperature of the incubator sometimes during the mid-period of embryonic development.

We have made a further and more detailed study of the temperature changes of the developing chick by the method of cultivation in an opened egg.<sup>8, 9</sup> The plotted data in Fig. 1 in general agree with previous investigations, perhaps with the exception that at later stages of incubation the values are not so low as those of Eycleshymer,<sup>6</sup> observed in water at 36.7° C., and not so high as those of Penjonschkewitsch and Rotanow,<sup>7</sup> observed in a still-air type incubator at 38.5° C. It is not unusual to observe such variation because both hypo- and hyperthermia in precocious birds can be produced experimentally<sup>10</sup> even after hatching when there is a depression or elevation in the environmental temperature.

Our curve demonstrates that the developing chicken egg, although producing heat, at first behaves as a poikilothermic or "cold-blooded" animal. In a few days of incubation the temperature of the egg rises above that of the temperature of the incubator, and the embryo gradually becomes a homeothermic or "warm-blooded" animal. However, the true homeothermy presumably is not acquired by the chick until the fourth or fifth day after hatching<sup>11</sup>

It is also interesting to note that the rise in temperature of the developing egg is not uniform but is somewhat periodic. The periods of decline in the temperature of the egg about the 9th or 10th day and

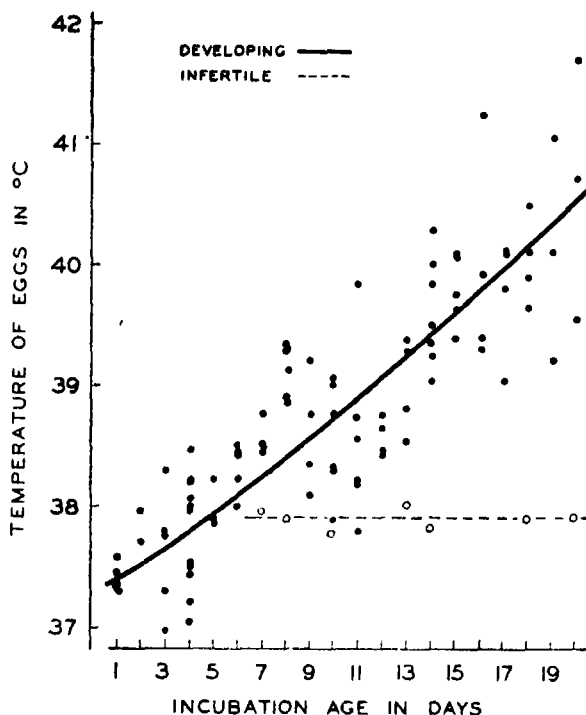


FIG. 1. Temperature changes of the developing eggs. Each dot represents the average value of several measurements on an individual egg. Circles indicate the temperature measurements of infertile eggs. All observations were made in the glass top incubator with slow air movement at the temperature on the level of thermocouple 37.75° C.

the 15th or 16th day coincide with the observed cyclical suppressions in the growth rate of the embryo.<sup>12</sup>

ALEXIS L. ROMANOFF

(CORNELL UNIVERSITY

## SCIENTIFIC APPARATUS AND LABORATORY METHODS

### AN A. C. OPERATED ELECTRONIC INDUCTORIUM

ALL the various types of electronic inductoria with which the writer is familiar seem to have been designed to do some specific task and, consequently, little thought seems to have been given to the general applicability or low cost of these designs.<sup>1</sup> There has been

<sup>4</sup> M. S. Pembrey and M. H. Gordon, *Jour. Physiol.*, 16: v-vii, 1894.

<sup>5</sup> M. S. Pembrey, M. H. Gordon and R. Warren, *Jour. Physiol.*, 17: 331-348, 1894-95.

<sup>6</sup> A. C. Eycleshymer, *Biol. Bull.*, 12: 360-374, 1907.

<sup>7</sup> E. E. Penjonschkewitsch and A. N. Rotanow, *Arch. Gefugellkunde*, 8: 369-383, 1934.

<sup>8</sup> A. L. Romanoff, *Anat. Rec.*, 48: 185-189, 1931.

<sup>9</sup> This method permits to maintain a very uniform temperature in the egg free from interferences either of air movement or of changes in atmospheric pressure caused by the presence of egg-shell. The measurements were

a need for an inductorium that would answer the everyday requirements of a physiology laboratory at the low cost and great convenience associated with most electronic devices.

Several inductoria have been constructed here which make use of the familiar saw-tooth wave generator circuit. They have been used for three years in the physiology and the pharmacology departments and have given trouble-free service with a considerable saving in the usual time of experimentation. The circuit

made by a thermocouple through the window of the egg at temperature of 37.75° C.

<sup>10</sup> J. C. Scholes, Thesis, Cornell University, 1938.

<sup>11</sup> W. F. Lamoreux and F. B. Hutt, *Poultry Sci.*, 18: 70-75, 1939.

<sup>12</sup> A. L. Romanoff, *SCIENCE*, 70: 484, 1929.

<sup>1</sup> F. A. Fender, *SCIENCE*, 89: 491, 1939; O. A. Schmitt and O. F. Schmitt, *ibid.*, 76: 328, 1932; O. A. M. Wyss, *ibid.*, 84: 431, 1937.

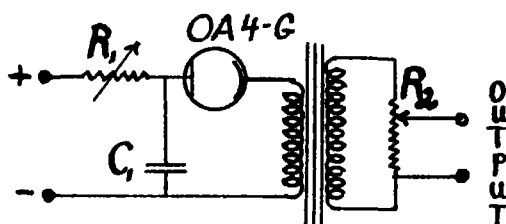


FIG. 1

diagrammed here provides frequency of stimulating impulses adjustable between the range of 2 to 60 impulses per second. Voltage and frequency are independently controlled by dials, single stimuli are obtained by operation of a push-button and a signal magnet is operated simultaneously with stimuli.

Fig. 1 is the schematic diagram of the stimulating voltage circuit. Variable resistor  $R_1$  controls the frequency of the discharge of condenser  $C_1$  through the primary of the transformer  $T_2$ . Stimulating voltage

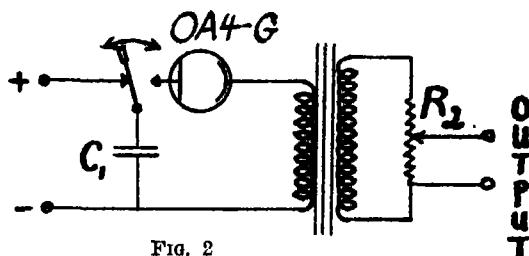


FIG. 2

- $T_1, T_2$  : 35-40 watt power transformer, 650 v, 6.3, and 5 volt secondaries  
 Tubes : 5W4 rectifier; OA4-G gas-filled tube  
 $R_1$  : 2 meg variable resistor  
 $SW_1$  : SPDT switch  
 $R_2$  : 20,000 ohm wire wound potentiometer  
 $SW_2$  : SPST switch (mounted on  $R_4$ )  
 $R_3$  : 30,000 ohm  $\frac{1}{2}$  W.  $R_4$  : 5,000 ohm 2W  
 $R_5, R_6$  : 100,000 ohm 1 W  
 $C_1$  : 0.1 mfd., 1,000 v condenser  
 $C_2$  : 8 mfd., 450 working volts electrolytic condenser

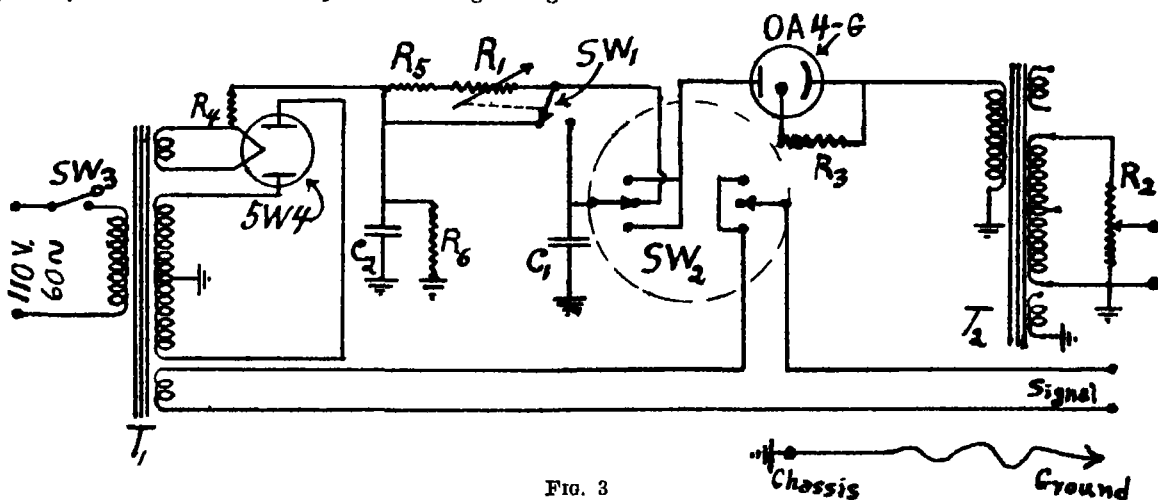


FIG. 3

is controlled by adjusting  $R_2$ . It is apparent that there is no interaction of controls  $R_1$  and  $R_2$ . In Fig. 2 the schematic diagram for obtaining single stimuli is shown, and Fig. 3 is the actual circuit diagram of the entire apparatus.

In Fig. 3, switch  $SW_2$  is a CRL type 1467, which functions in one position as a push-button, or key, and in the other position as a toggle switch.  $SW_1$ , which mounts on the frequency control,  $R_1$ , changes the circuit from that of Fig. 1 to that of Fig. 2. A ground wire for the chassis of the instrument is provided to prevent stray contractions caused by stray charges in the instrument.

All components mount in a commercial cabinet, 6" x 6" x 6". The controls and switches are on the top cover of the cabinet, and all other parts mount on a 5" x 5" sub-panel, suspended below the top cover.

Values of the parts, available at all large radio supply stores, follow:

A. B. CULLEN, JR.

UNIVERSITY OF MISSISSIPPI

## BOOKS RECEIVED

- BRINKLEY, STUART R. *Principles of General Chemistry*. Third edition. Pp. x + 703. 179 figures. Macmillan. \$4.00.  
 BUROS, OSCAR K., Editor. *The Second Yearbook of Research and Statistical Methodology*. Pp. xx + 383. Gryphon Press, Highland Park, N. J. \$5.00.  
 CASE, VIRGINIA. *Your Personality—Introvert or Extrovert?* Pp. viii + 277. Macmillan. \$2.50.  
 DOLE, MALCOLM. *The Glass Electrode*. Pp. xv + 332. Illustrated. Wiley. \$4.50.  
 FORDER, HENRY G. *The Calculus of Extension*. Pp. xv + 490. Cambridge University Press, Macmillan. \$6.75.  
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## THE NEW FRONTIERS IN THE ATOM<sup>1</sup>

By Professor ERNEST O. LAWRENCE

THE UNIVERSITY OF CALIFORNIA

THE anniversary celebration of a great university is indeed an important occasion, and it is appropriate to signalize the event by a symposium on "The University and the Future of America," for a great institution of learning is eternally youthful, and youth looks always to the future. I am greatly honored to be included in this distinguished gathering, and it gives me especial pleasure to join in wishing our sister institution many happy returns.

In a discussion bearing on the future, the scientist is always in something of a dilemma. On the one hand, he is cautioned to make only very limited prognostications,

for he has learned the very limited region of applicability of existing knowledge and the likelihood of error in speculation. On the other hand, he faces the future with eager excitement and curiosity about what is beyond the present frontiers of knowledge, and he is naturally tempted to speculate and indeed to indulge in daydreams. Perhaps I may convey something of what is in the minds of physicists these days by a brief discussion of some recent developments of the current intensive attack on the new frontier in the atomic world—the nucleus of the atom.

## ATOMS

The atomic constitution of matter has long been a keystone of natural science. At the beginning of this

<sup>1</sup>An address delivered at the fiftieth anniversary celebration of Stanford University, June 16. It will appear with illustrations in a volume to be published by the Stanford University Press.

century it was a keystone in a structure having as pillars the principles of the conservation of energy and the indestructibility of matter. In the nineties, it was almost axiomatic to say that the building blocks of nature are the atoms—indivisible, indestructible entities, permanent for all time. But the discovery of radioactivity altered all this. There followed the discovery of the electron and the proton as smaller and more fundamental constituents of matter and the atom itself became the happy hunting ground of the experimental physicist. Atomic physics developed rapidly; for the atom was found to be a domain of almost incredible richness, and to-day, thanks perhaps to the newspapers, our children speak knowingly of smashing atoms!

To explain the wonderful phenomena of radioactivity, Rutherford came forward in 1904 with a revolutionary hypothesis which reduced the complicated and mysterious observations of radioactivity to simple order. According to Rutherford, not all the atoms have existed for ages and will exist for all time, but there are some atoms in nature that are energetically unstable and in the course of time, of their own accord, blow up with explosive violence. These are the natural radioactive substances, and the fragments given off in the atomic explosions are the observed penetrating rays.

It was not long before Rutherford's hypothesis was established as a law of nature and formed a greater keystone, replacing the chemists' conception of the atom and serving as a foundation for a new science, the science of the atomic nucleus.

Time does not permit an adequate historical résumé of the development of nuclear physics, but for the present purpose it is sufficient to say that the ideas of Rutherford and Bohr on the structure of atoms are now firmly established. There is an abundance of evidence that an atom consists of a nebulous cloud of planetary electrons whirling about a very dense sun, the positively charged nucleus, and that it is in the nucleus that the atomic explosions of radioactivity occur. Indeed, our assurance that this is so rivals our confidence that the planets revolve about the sun!

#### ATOMIC NUCLEUS

Let us now proceed immediately to a consideration of the structure of the nucleus. The nucleus consists of a closely packed group of protons and neutrons, elementary building blocks of nature some 2,000 times heavier than the electrons. The neutrons are electrically neutral while the protons carry positive charges and for each proton in the nucleus there is a corresponding negative electron outside, for the atom as a whole is uncharged. Since the number of electrons

outside determines the ordinary chemical and physical properties of the atom, it follows that the nuclear charge determines the place of the atom in the periodic table of the elements.

Thus, the nucleus is the body and soul of the atom. More than 99.9 per cent. of the atom's mass is in the nucleus and the nuclear charge determines the nature of the atom, its chemical and physical properties.

#### TRANSMUTATION OF THE ELEMENTS

These considerations reduce the age-old problem of alchemy to simple terms. For we see to change one element into another is simply to change the nuclear charge, *i.e.*, the number of protons, in the nucleus. The subject of transmutation of the elements has recently received a great deal of attention in the laboratory. All sorts of transmutations have been produced in a minute scale—helium has been made from lithium, magnesium from sodium and even mercury has been turned into gold. The day may come when we will indeed possess the philosopher's stone and will be able to transmute the elements on a grand scale. But interesting as these developments are, I should like to draw your attention to two other subjects, artificial radioactivity and the question of tapping the vast reservoir of energy in the nucleus of the atom.

#### ARTIFICIAL RADIOACTIVITY

One of the early results of atomic bombardment was the discovery that neutrons could be knocked in or knocked out of the nucleus to produce radioactive isotopes of the ordinary elements. Thus, for example, the nucleus of the ordinary sodium atom contains 11 neutrons and 12 protons, 23 particles in all, and so it is called sodium 23 (or  $\text{Na}^{23}$ ); and by bombardment it was found that a neutron could either be added to make sodium 24 or subtracted to make sodium 22, both isotopic forms not occurring in the natural state. The reason that these synthetic forms are not found in nature is that they are energetically unstable. They are radioactive and in the course of time blow up with explosive violence. Sodium 24 has a half-life of 14.5 hours, *i.e.*, it has an even chance of disintegrating in that time, turning into magnesium by the emission of an electron. Sodium 22, on the other hand, has a half-life of 3 years and emits positive electrons to turn into stable neon 22.

These artificial radioactive isotopes of the elements are indistinguishable from their ordinary stable relatives until the instant they manifest their radioactivity. This fact deserves emphasis, and it may be illustrated further by the case of chlorine. Chlorine consists of a mixture of two isotopes, 76 per cent. of  $\text{Cl}^{35}$  and 24 per cent. of  $\text{Cl}^{37}$ , resulting in a chemical

atomic weight of 35.46 which is the average weight of the mixture. By elaborate technique, to be sure, it is possible to take advantage of the extremely slight difference in chemical properties and bring about separation of these isotopes, but in ordinary chemical, physical and biological processes, the chlorine isotopes are indistinguishable and inseparable. The artificial radioactive isotopes  $\text{Cl}^{34}$  and  $\text{Cl}^{36}$  are likewise indistinguishable. In fact,  $\text{Cl}^{34}$  is more nearly identical in properties to the natural isotope  $\text{Cl}^{35}$  than is the other natural isotope  $\text{Cl}^{37}$ . And again I would say that the radioactive characteristic of  $\text{Cl}^{34}$  becomes evident only at the moment it blows up to turn into the neighboring element sulfur.

#### RADIOACTIVE TRACER ATOMS

In these radioactive transformations of the artificial radioactive isotopes, the radiations given off are so energetic that the radiations from individual atoms can be detected with rugged and reliable instruments, called Geiger counters. Thus, radioactive isotopes can be admixed with ordinary chemicals to serve as tracer elements in complicated chemical or biological processes.

As an illustration of the power of this new technique of labeling and tracing atoms, let us consider iodine in relation to the thyroid gland. It is well known that the thyroid takes up and stores iodine, and this fact can be demonstrated strikingly by feeding an individual iodine including a small quantity of radioactive iodine. Before the feeding, the radioactivity of the food can be measured by placing it near a Geiger counter, thereby giving a measure of iodine content. Later the progress of the iodine through the body can be observed by placing the Geiger counter next to various parts of the body. Likewise, the proportion of the fed iodine in the various body fluids at any time can be determined quickly by taking small samples of the fluids and measuring their radioactivity. After some hours it is found that a large part of the iodine taken in has collected in the thyroid, a fact that is readily established by placing a Geiger counter next to the gland [lantern] and observing the activity while finding no appreciable activity elsewhere. This technique makes it possible to study the behavior of the thyroid in health and in disease, and much interesting work along this line has been carried out recently.

#### RADIO-AUTOGRAPHY

Although the tracer elements are readily detected with the Geiger counter, there is a photographic method which for many purposes has obvious advantages. This method is sometimes called radio-autography and is illustrated by the lantern slide. Here a

minute amount of radioactive phosphorus in the form of sodium phosphate was added to the nutrient solution of a tomato plant, and after a day or so leaves were placed against a photographic film enclosed in a light-tight paper envelope. The penetrating rays from the radioactive phosphorus produced the developed contact image shown, which gives an accurate and detailed picture of the uptake of phosphate by the plant. Now, indeed, the same method works very well also for the thyroid, as is shown in the lantern slide, which is a photomicrograph of a thin section of thyroid tissue containing radio-iodine; alongside is the radio-autograph obtained from the same micro section by placing it against a photographic plate. The distribution of the iodine in various parts of the gland is shown in surprising detail.

Similarly striking radio-autographs of the distribution of phosphorus and strontium in rats are shown in the lantern slide. Here two rats were fed radio-phosphorus and radio-strontium respectively, and then some hours or days later they were sacrificed, and frozen sections of the entire bodies of the animals were placed against a photographic plate. The resulting radio-autographs show clearly that both strontium and phosphorus are selectively deposited in the bones, phosphorus being more widely distributed in other tissue. The distribution of the strontium in the bones also appears to be quite different from that of phosphorus as radio-autographs of the sections of bones clearly show [lantern].

These examples serve to illustrate the power of the new technique of radioactive tracer atoms. It has often been said that the progress of science is the progress of new tools and new techniques, and I think we may look forward to accelerated developments in biology resulting from the tracer elements.

#### ARTIFICIAL RADIOACTIVE SUBSTANCES IN THERAPY

It is somewhat afiel for me to discuss medical problems, but I should like to direct your attention to the possibilities of the artificial radioactive substances in the treatment of cancer and allied diseases. It is well known that at the present time there are two main approaches to the treatment of neoplastic disease, surgery and radiation. It is sometimes possible to cut out a cancer completely and effect a cure, and in other circumstances, it is possible to destroy a tumor by irradiation with x-rays or radium. The mechanism whereby the radiation destroys the tumor without destroying an excessive amount of surrounding normal tissue is doubtless extremely complicated, but in any case it is evidently important to localize the radiation to the tumor as much as possible. Perhaps the ideal would be approached if a means were at hand to

irradiate each and every malignant cell without irradiating a single normal cell.

The artificial radioactive substances open for the first time the possibility of an approach to such selective irradiation of tissue. The above examples of tracers suggest the treatment of thyroid tumors with radioactive iodine, bone tumors with radioactive strontium and radioactive phosphorus. These possibilities are being investigated as is the more specific problem of finding a radioactive substance that is selectively taken up by tumor tissue. If there were time, I should like to describe work along this line in progress in several laboratories, and especially to speak of the important progress that is being made in the treatment of leukemia, but I must content myself with only mentioning these new developments in medicine, which are so promising for the future.

#### ATOMIC ENERGY

For a long time astronomers have been vexed with a problem, the problem of the source of stellar energy, for there is evidence that the sun has been blazing at its present brilliance for thousands of millions of years, and no ordinary fuel could be responsible for such an eternal fire.

The discovery of radium posed to the physicist a similar difficulty; for it was found that radium gives off every hour enough energy to heat its own weight of water to boiling, and this it continues to do for more than a thousand years. Such a vast source of energy in the radium atom was as difficult to understand as the evidently limitless store of heat in the sun. The problem was of fundamental interest and all sorts of possibilities were considered even to the abandonment of the principle of the conservation of energy.

But the first clue to the solution of the problem appeared in 1905 when Einstein announced the theory of relativity. One of the revolutionary consequences of the theory was that matter is a form of energy and that presumably in nature processes go on in which matter is destroyed and transformed into more familiar forms of energy such as heat, radiation and mechanical motion. The relativity theory gave as the conversion factor relating mass to equivalent energy, the square of the velocity of light, a very large number, even to an astronomer! Thus, the theory indicated that, if a glass of water were completely destroyed, more than a billion kilowatt hours of energy would be released, enough to supply a city with light and power for quite a time!

This exciting deduction was immediately accepted by the astronomers, who said, "Doubtless within the sun conditions are such that matter is being trans-

formed to heat. Thus, slowly through the ages the sun is losing mass; its very substance is radiating into space."

Likewise, the physicists, who had other compelling reasons for accepting the Einstein theory, concluded that the source of the energy in the radium atom was a destruction of matter in the atomic explosion giving rise to the penetrating rays.

Although the fundamental assumptions on which the relativity theory was based were evidently sound, and the explanations of the source of energy of the sun and stars and radioactivity were most attractive, until direct experimental verification was forthcoming, Einstein's great deduction could not be regarded as an established law of nature.

The first direct evidence of the truth of this fundamental principle was obtained in the first atom-smashing experiments a decade ago. It was observed that, when the nucleus of a lithium atom is hit by a proton having a kinetic energy of less than a million electron-volts, the result is the formation of two helium nuclei which fly apart with an energy of more than 17 million electron-volts; thus in the nuclear reaction in which hydrogen and lithium unite to form two helium atoms, there is a great release of kinetic energy.

Now one of the interesting and important occupations of the experimental physicist has been the measurement of the masses of atoms and the weights of atoms are known with great precision—much greater than any individual knows his own weight. In particular, it was known precisely that a lithium atom and a hydrogen atom have a total weight slightly greater than the weight of two helium atoms, and it was a great triumph for the Einstein theory when measurements showed that the excess kinetic energy with which the helium atoms flew apart in the hydrogen-lithium reaction corresponded exactly with the disappearance of mass according to the mass energy relation. Literally hundreds of similar nuclear reactions have been studied in the intervening years, and in each instance the Einstein relation has been verified. At the present time this great principle has as firm an experimental foundation as any of our laws of nature.

#### URANIUM FISSION

Now that it is an experimental fact that matter can be converted into energy, it becomes of great practical importance to inquire whether the vast store of energy in the atom will be tapped for useful purposes. This question has recently taken on added interest through the discovery of a new type of nuclear reaction involving the heavy element uranium.

It has been known for some years that the heavy

elements, such as lead, gold and uranium, are relatively heavier than the middle weight elements, as copper and iron, or more precisely that the average weight of the neutrons, protons and electrons in the heavy elements is greater than their average weight in the atoms near the middle of the periodic table. Accordingly, it is to be expected that, if heavy atoms were split approximately in two, forming corresponding middle weight atoms, there would be a vast release of energy corresponding to the disappearance of matter in the transformation. Indeed, from known values of the masses, it can be calculated on the basis of Einstein's mass-energy relation that each splitting or fission, as the process is called, of a uranium atom into two approximately equal parts releases an energy of about 200 million electron-volts, which is millions of times more heat per atom than is given off when ordinary fuel is burned. Thus, calculations show that 100 pounds of uranium would yield a billion kilowatt hours, which at one cent per kilowatt hour would be ten million dollars' worth of electrical energy.

For some time these considerations were largely academic because no way was known for producing fission of the heavy elements. But interest in the matter has now become extremely lively as a result of the discovery that fission of uranium is actually brought about by bombarding it with neutrons.

The phenomenon has, during the past two years, received intensive study in laboratories all over the world, and several salient facts have emerged. First, the rare  $U^{235}$  isotope undergoes fission after absorption of a slow neutron. Second, the energy released in the fission process has been measured; and, as expected, it is found that, when a neutron having an energy less than an electron-volt enters the  $U^{235}$  nucleus, about 200 million electron-volts of energy is released. Third it is found also that the fission process is so violent that usually the  $U^{235}$  nucleus does not break up into two parts only, but more often several neutrons are given off in addition to the two large fragments.

That neutrons are generated in the fission process is of the greatest interest because it opens up the possibility of a chain reaction, a series of nuclear reactions wherein the neutrons liberated in one fission process go on to produce additional fissions in other atoms which in turn give rise to more neutrons which produce further fissions and so on. It is this possibility of a chain reaction that has excited the interest in uranium as a practical source of atomic energy.

Without going into further detail, it is perhaps sufficient to say that there is some evidence now that, if  $U^{235}$  could be separated in quantity from the natu-

ral mixture of the isotopes, a chain reaction could, indeed, be produced. But herein lies the catch, for there is no practical large-scale way in sight of separating the isotopes of the heavy elements, and certainly it is doubtful if a way will be found.

But I should not want to indicate that the uranium matter is a disappointment, that after all we shall never find a way to bring about fission of the heavy elements for useful purposes. Quite the contrary!

The present situation is not unlike the circumstances fifty years ago surrounding the then great question of whether man would ever be able to fly. In those days the fundamental laws of classical mechanics were known, and they allowed the possibility of heavier than air flight. Moreover, there was an abundance of supporting observational evidence that flight should be possible; there were kites and there were the birds of the air. But man's realization of the dream awaited primarily the development of the combustion engine, a circumstance not so evidently connected with the fundamental problems of flight. Likewise the fundamental laws of nature recently revealed to us allow the possibility of obtaining useful nuclear energy, and radium and the sun and stars bear witness that this vast source of energy is being tapped in nature. Again success in this direction may await the development of a new instrument or technique just as the airplane depended on the gas engine.

Perhaps the problem awaits a deeper understanding of the forces that hold nuclei together. That there are little understood forces operative in the nucleus is more than evident; especially from observations of the cosmic rays, it has been established that particles of matter called mesotrons of intermediate mass between electrons and protons play a dominant role in nuclear structure. Theoretical considerations suggest that the mesotrons may be connected with the primary forces in the nucleus, and accordingly, an understanding of mesotron forces may ultimately yield the solution of the practical problem of atomic energy.

#### THE GIANT CYCLOTRON

In order to study experimentally the mesotron problem, it is necessary to bombard nuclei with atomic projectiles having energies in the range of 100 million electron-volts rather than in the neighborhood of 10 million electron-volts at present available in cyclotron laboratories. To this end a giant cyclotron is now under construction on Charter Hill in Berkeley, and I should like to conclude with some pictures of this great machine. Whether it will be the key to the vast store of energy in the atom, what new discoveries, what new insight into nature it will bring—only the future will tell!

## OBITUARY

## HOWARD WALTON CLARK

HOWARD WALTON CLARK, curator of the department of ichthyology of the California Academy of Sciences, died on August 10, after a short illness. He was born in Allen County, Indiana, on September 9, 1870, gained his early education in public schools, and graduated from Indiana University in 1896, receiving the A.M. degree in 1901. From his earliest boyhood his interests turned toward natural history, and it almost instinctively became his life work. He served as preparator in the Field Museum, Chicago, from 1901 to 1904, and as assistant in the U. S. Bureau of Fisheries from 1904 to 1909. From 1910 to 1923 he was scientific assistant in the Biological Station of the U. S. Bureau of Fisheries at Fairport, Iowa, largely engaged in the study of the life history and economic importance of the fresh-water mussels and similar problems. In 1923 he went to California and served as collector and aquarist for the newly opened Steinhart Aquarium of the California Academy of Sciences until 1925, when he became assistant curator of the department of fishes in the museum of the academy from 1925 to 1933, and the curator of ichthyology from 1933 until his death.

Mr. Clark was a versatile naturalist, equally at home in both zoology and botany, a keen and tireless observer in the field and laboratory. Aside from a considerable number of other publications in systematic zoology and botany, his collaboration with the late Dr. Barton Warren Evermann produced their masterly study "Lake Maxinkuckee, a Physical and Biological Survey," in two volumes, issued by the Department of Conservation of the State of Indiana in 1920, which stands as a classic in its field. In addition to much of the first volume the second, dealing with the flora of the region, is almost entirely the work of Mr. Clark. It is based upon field studies extended through several years at intervals, and much interrupted by other work, and is not merely a list of plants collected, but is rich in ecological detail, enlivened here and there with bits of description of high literary merit. As joint author with David Starr Jordan and Barton Warren Evermann he published in 1930 their large "Check List of the Fishes and Fish-like Vertebrates of North and Middle America," invaluable for the systematic ichthyologist. The extension and revision of this work has been continuously carried on by Mr. Clark since its appearance with the idea in mind of a revised edition. In addition to his own studies he edited the notices of ichthyological literature appearing in *Biological Abstracts* since its foundation, and countless careful reviews appearing in it were his faithful work.

A man of wide interests, a cordial and sincere personality, blessed with a keen sense of humor, he was at all times helpful and stimulating to his colleagues, and ever ready to promote their interests and those of the academy he served so well.

F. M. MACFARLAND

CALIFORNIA ACADEMY OF SCIENCES

## DEATHS AND MEMORIALS

DR. WILLIAM NEWTON LOGAN, until his retirement in 1936 professor of economic geology and mineralogy at Indiana University and state geologist of Indiana, died on August 27 in his seventy-second year.

AUGUST EIMER, who retired ten years ago as president of the drug and chemical firm of Eimer and Amend, New York City, died on August 28.

THE death by suicide on August 25 is reported of Walters Moseley, professor of chemistry and head of the department of Tulane University. He was fifty-three years old.

DR. A. J. CLARK, professor of materia medica in the University of Edinburgh, died on July 30 at the age of fifty-six years.

A WIRELESS dispatch to *The New York Times* dated August 26 states that Dr. Kazimierz Bartel, professor of mathematics at the University of Lwow and at the Polytechnic Institute, prime minister of Poland from 1926 to 1930 and senator in 1935, has been shot by the Gestapo. The dispatch states that sixty professors of the University of Lwow, in which Professor Bartel taught, have been arrested and that their fate is unknown. According to the Associated Press, Professor Bartel refused to leave Lwow when the Russians withdrew after the outbreak of the German-Russian war, and was arrested when the Nazis took over the city. He was fifty-nine years old.

THE correspondent of the *London Times* at Buenos Aires, under date of August 4, writes: "In the presence of the British and United States Ambassadors, a bronze plaque was unveiled yesterday to the memory of William Henry Hudson at Berazategui, in the province of Buenos Aires, to commemorate the centenary of the writer's birth. Dr. Fernando Pozzo, president of the Committee of Homage, announced the foundation of the Association of the Friends of Hudson, whose chief objects, he said, would be to acquire the property of Veinte y Cinco Ombues, in Quilmes, the suburb of Buenos Aires where Hudson was born, and to create there a bird sanctuary and a museum of ornithology."

## SCIENTIFIC EVENTS

THE ROYAL OBSERVATORY, GREENWICH<sup>1</sup>

THE annual report of the Astronomer Royal, just published, refers to the work of the Royal Observatory during the period May 1, 1940–April 30, 1941. To those who know the position of the observatory, in the midst of military and industrial objectives, it will come as no surprise that much of the work has been curtailed by enemy action. The last report mentioned the dismantling of much of the optical apparatus; most of the mirrors and lenses have now been sent away from Greenwich for safety. Since heavy bombing of London started last September, night observations have been impossible on such of the telescopes as had not already been dismantled at the outbreak of hostilities; in fact, the only observing programs still carried on at Greenwich are daylight ones, namely, the routine meteorological work and the photographic and visual solar observations.

The public time service functions well from two emergency outstations, as the familiar "six pips" regularly testify. The Rugby rhythmic signals, however, in present circumstances fall short of the high precision needed for control of frequency standards, though they are, of course, quite adequate for navigation. Rating of chronometers and watches and their issue to the Royal Navy continue as usual, though the entire establishment concerned has been moved for the second time in two years.

Work has ceased on the Airy transit circle after continuous observation with this instrument for ninety years. More than 650,000 observations have been made with it, forming the most important contribution from a single instrument to fundamental positional astronomy. The new reversible transit circle which is to take its place has obtained nearly 10,000 transits during the last three years. When observing ceased in September, 1940, the work of determining the division errors had been completed and an investigation started on the irregularities of the pivots. These latter have already been found to be extremely small.

The photoheliograph and spectrohelioscope observations show the expected decline in solar activity from the 1937–38 maximum, the sunspot frequency having dropped to about half that at maximum. Nevertheless, twenty-one large groups of spots occurred, six of them being later associated with magnetic storms. One of these latter, that of March 1, 1941, ranks high among the most severe disturbances of the past ninety years. The associated spot could not be extensively observed because of cloud,

<sup>1</sup> From *Nature*.

but the number of short-wave radio fade-outs occurring during its central meridian passage suggests that it was chromospherically very active. Over the year as a whole, however, both chromospheric eruptions and radio fade-outs were few.

The meteorological department of the observatory has celebrated its centenary of routine observations. Features of the year's weather include an August drier than any for 122 years, and a period from December to April during which each month was considerably colder than normal, the temperature in the Stevenson screen never reaching 59° F. for the whole five months.

Discussion of the photographic material, comprising nearly 3,000 plates, obtained during the 1931 opposition of Eros, is now practically complete. The solar parallax deduced from these observations at stations all over the world is  $8.790'' \pm 0.001''$ , the previously accepted value being  $8.80''$ .

The "Nautical Almanac" office continues its essential work, though it has had to contend with the destruction by fire of the whole of the type and plates for all its publications except the "Astronomical Navigation Tables." The consequent delay in publication is being rapidly made good, in some cases by using photographic reproduction in lieu of printing from type.

Astronomers all over the world will join in sympathizing with the Astronomer Royal and his staff on the interruption of many of their long-established programs, and in congratulating them on their maintenance of essential services throughout a very trying period.

## COSMIC RAY INVESTIGATIONS

RESULTS of cosmic ray investigations in the Andes ranging up to 19,200 feet—nearly a mile higher than the highest peak in the United States—were reported on his return to the United States on August 22 by Dr. Arthur H. Compton, of the University of Chicago, leader of the expedition. These are, according to the official announcement:

1. At an altitude of more than 15,000 feet on the site of a Cerro de Pasco Corporation mine near Oroya in central Peru, Drs. Ernest O. Wollan and Donald Hughes photographed tracks of cosmic ray particles with a cloud chamber. They had 9,000 pounds of equipment, including the large permanent magnet used in high altitude experimental airplane flights in this country. Their chief finding was clear photographic evidence of the production of groups of positive and negative mesotrons.

2. Working on Mount El Misti in southern Peru at altitudes up to 19,200 feet, Dr. Norman Hilberry and his wife, Dr. Ann Hepburn Hilberry, verified fundamental

theories on the origin of giant cosmic ray showers, establishing the "peak" of their occurrence at approximately 16,000 feet.

3. Staging the first stratosphere balloon flights at the equator seeking information on mesotrons, rays produced by collision of a cosmic ray and nucleus of an atom in the atmosphere, Drs. William P. Jesse, of the University of Chicago, and Paulus A. Pompeia, of the University of São Paulo, Brazil, have already recovered one flight which is now being studied and are continuing their investigations.

The University of Chicago expedition, aided by the Nelson Rockefeller Committee on Cultural and Commercial Relations between the American Republics, started two months ago. Its members included Dr. Pompeia, of the University of São Paulo, who had been at the University of Chicago for the last year; Professor Norman Hilberry, now of New York University, and other members of the scientific staff of the University of Chicago.

The expedition had as its scientific objectives procurement of data from equatorial locations and elaboration of experiments conducted in the United States at various elevations.

The Oroya investigations were similar to those conducted in the Denver mountain parks, cooperatively by the University of Denver, the Massachusetts Institute of Technology, Cornell University and the University of Chicago. At the Oroya site, however, the investigators were able to get the same equipment to a point a thousand feet higher than any mountain in this country. The resulting pictures of tracks of cosmic ray particles show production of groups of positive and negative mesotrons and lay the basis of possible analysis of the particles.

At the Oroya site, the same permanent magnet was used as in high-altitude plane flights made two years ago at Chicago for cosmic ray investigations. With the advantage of longer time and less cramped conditions for observations, evidence corroborating indications from the airplane observations was procured.

The Hilberrys set up three observation stations on El Misti, at 7,500, 15,500 and 19,200 feet, using a mule train to reach their posts and carrying oxygen, though they did not find it necessary to use it. The same height for observations was reached in the Himalayas nine years ago, but reaching this height required two weeks against a day and a half in the Andean location. The El Misti base was at Arequipa.

The chief finding of the El Misti investigation was the greatest abundance of giant showers of cosmic rays at approximately 16,000 feet and laying of groundwork for reliable estimates of the maximum energy in primary cosmic ray particles. The theory had been that the showers of cosmic rays developed as they came down through the atmosphere. With ob-

servations made at the 16,000-foot or peak-level, this theory was corroborated. The maximum energy in the primary cosmic ray particle is estimated by physicists at approximately ten billion times the energy released by a radium ray, or enough energy in a single atom to lift one's finger off the table.

The balloon flights staged by Drs. Pompeia and Jesse at São Paulo were designed to investigate further the hypothesis that the cosmic ray particle entering the earth from outside the atmosphere is the proton; and to discover whether mesotrons are produced with higher energy at the top of the atmosphere near the equator than at the top of the atmosphere over Chicago.

Other flights have been made from the equator, but these are the first flights designed for mesotron information. The results will be compared with results of similar flights in Texas and Chicago to determine the comparative energies in various parts of the ceiling of the atmosphere.

#### COMMISSION TO CHINA ON MALARIA CONTROL

At the request of the Chinese Government, this country will send a commission of medical and sanitary officers and entomologists to control malaria and supervise sanitation and medical care of 250,000 Chinese laborers to be employed in the construction of a railroad in the Chinese Province of Yunnan. The commission is appointed by Surgeon General Thomas Parran and will be headed by Dr. V. H. Haas, of the Public Health Service. It will consist of some sixteen American members.

The malaria control will be undertaken in one of the most highly malarious sections of China. In addition, general sanitary and medical supervision of the workers will be undertaken by the commission. Approximately \$1,140,000 has been supplied the project by this government under terms of the Lend-Lease Act. Salaries of laborers and of medical and sanitary officers supplied by the Chinese Government will be paid by China. The \$1,140,000 will pay for salaries and expenses of the American members of the commission and for drugs and chemicals and medical supplies.

The Rockefeller Foundation was asked to assist by making available the services of some of its personnel. D. E. Wright, a sanitary engineer on the staff of the International Health Division, has been assigned for full-time service with the commission. Dr. Marshall C. Balfour, regional director for the International Health Division in the Far East, is serving intermittently as consultant. There will also be cooperation with the laboratory for malaria investigations at Chefang on the Burma Road.

Members of the commission will leave for China at

intervals beginning on September 21, when Dr. Haas will leave San Francisco by clipper. It is expected the commission will operate for about a year.

### THE FIFTIETH ANNIVERSARY OF THE UNIVERSITY OF CHICAGO

THE closing events of the celebration of the fiftieth anniversary of the University of Chicago will be held from September 22 to 29. The exercises will center about the subject of "New Features in Education and Research." Details of the program have been printed in the issues of *SCIENCE* for July 11 and August 15.

Attendance is expected to reach ten thousand. The American Association for the Advancement of Science will meet at the university during the week. Many scientific men from this country and abroad, including many refugee scholars, are expected to be present.

At the anniversary convocation on September 29 President Robert M. Hutchins will make an address and thirty-four honorary degrees will be conferred. The academic festival will end with a luncheon for the visiting delegates of more than four hundred colleges, universities, research institutions and learned societies. Speakers after the luncheon will be President James B. Conant, of Harvard University; President Robert G. Sproul, of the University of California, and President Mildred McAfee, of Wellesley College.

Preceding the special convocation on September 27, President Homer P. Rainey, of the University of Texas, and President Hutchins will speak at the annual alumni assembly; Professor Louis Gottschalk will speak at the Phi Beta Kappa dinner, and official delegates from colleges and universities will attend a reception given by deans of the university.

On Sunday, September 28, an anniversary service of commemoration and thanksgiving will be held in Rockefeller Memorial Chapel, followed by a reception for the delegates given by President and Mrs. Hutchins. President Hutchins will be among the speakers on a special broadcast of the University of Chicago Round Table on the nationwide red network of the National Broadcasting Company at 1:30 P.M. At 8:30 P.M. a special festival concert by the Chicago Symphony Orchestra under the direction of Dr. Frederick Stock will be given in Rockefeller Memorial Chapel.

The festival will follow five days devoted to the meetings of learned societies (September 22 to 26),

in which more than a hundred and sixty scientific workers and scholars, including the thirty-four who will be the recipients of honorary degrees, will describe the results of their works.

### SYMPOSIA AT THE ATLANTIC CITY MEETING OF THE AMERICAN CHEMICAL SOCIETY

AN extensive program of symposia has been arranged by the various divisions of the American Chemical Society for the Atlantic City meeting, which will be held from September 8 to 12. They are as follows:

*Division of Agricultural and Food Chemistry*, Gerald A. Fitzgerald, *chairman*. "New Analytical Tools for Biological and Food Research." (Joint symposium with the Divisions of Biological Chemistry and Medicinal Chemistry), G. A. Fitzgerald, *presiding*.

*Division of Biological Chemistry*, Herbert O. Calvery, *chairman*. "Physicochemical Methods in Protein Chemistry." (Joint symposium with the Division of Physical and Inorganic Chemistry), D. A. MacInnes, *presiding*. "The Chemistry of Aging," Anton J. Carlson, *presiding*. "New Analytical Tools for Biological and Food Research." (Joint symposium with the Division of Agricultural and Food Chemistry and Medicinal Chemistry.)

*Division of Chemical Education*, R. D. Reed, *chairman*. "Professional Training of Chemists or Chemical Engineers," R. D. Reed, *presiding*.

*Division of Fertilizer Chemistry*, H. B. Siems, *chairman*. "Phosphates." (Joint symposium with the Division of Industrial and Engineering Chemistry.)

*Division of Industrial and Engineering Chemistry*, B. F. Dodge, *chairman*. "Unit Processes," R. Norris Shreve, *presiding*. "Symposium on Phosphates." (Joint symposium with the Division of Fertilizer Chemistry.) "Electrical Insulation Materials," R. N. Evans, *presiding*.

*Division of Medicinal Chemistry*, R. J. Fosbinder, *chairman*. "New Analytical Tools for Biological and Food Research." (Joint symposium with the Divisions of Agricultural and Food Chemistry and Biological Chemistry.)

*Division of Paint, Varnish and Plastics Chemistry*, G. G. Sward, *chairman*. "Progress in High Polymer Plastics," S. L. Base, *presiding*.

*Division of Physical and Inorganic Chemistry*, J. G. Kirkwood, *chairman*. "Physicochemical Methods in Protein Chemistry." (Joint symposium with the Division of Biological Chemistry.) "Magnetism and Molecular Structure," P. W. Selwood, *presiding*. "Elementary Reactions," F. O. Rice, *presiding*.

*Division of Rubber Chemistry*, R. H. Gerke, *chairman*. "Rubber for Defense," R. H. Gerke, *presiding*.

## SCIENTIFIC NOTES AND NEWS

DR. WILLIAM LLOYD EVANS, professor of chemistry and chairman of the department of the Ohio State University, will deliver on September 10 the presi-

dential address before the American Chemical Society meeting at Atlantic City. He will speak on "Some Less Familiar Aspects of Carbohydrate Chemistry."

At the dinner of the society on the evening of the same day an address entitled "The Chemical Warfare Service in National Defense" will be made by Major General William N. Porter, chief of the service. Addresses will be given at the opening meeting on September 8 by H. V. Churchill, of the Aluminum Company of America, on "Industrial Spectrochemical Analysis"; by Dr. B. L. Clarke, of the Bell Telephone Laboratories, on "The Electrographic Method of Analysis," and by V. K. Zworykin and James Hillier, of the RCA Manufacturing Company, on "Applications of the Electron Microscope." At this session presentation will be made of the Priestley Medal to Dr. Thomas Midgley, Jr., whose medal address is entitled "Demonstrations—A Historical Review." Dr. Karl August Folkers will receive the American Chemical Society Award of \$1,000 in Pure Chemistry. He will make an address describing his work.

At the annual meeting of the American Psychological Association, which is being held at Northwestern University on Wednesday, Thursday, Friday and Saturday of the present week, the address of the president, entitled "The Problem of General Quantitative Laws in Psychology," will be given by Dr. Herbert Woodrow, professor of psychology at the University of Illinois. In conjunction with the meeting of the association there are being held meetings of the American Association for Applied Psychology, with Dr. Edgar A. Doll, director of research at the Training School at Vineland, N. J., as president, who will give an address entitled "Scientific Freedom"; of the Society for the Psychological Study of Social Issues, with Dr. Floyd H. Allport, of Harvard University, as chairman, who will speak on "Methods in the Study of Collective Action Phenomena"; and of the Psychometric Society, of which Dr. Jack W. Dunlap, of the University of Rochester, is president, whose address is entitled "The Psychometric Society—Roots and Powers."

The Baly Medal of the Royal College of Physicians, London, has been awarded to Dr. Edgar Allen, professor of anatomy and chairman of the department at Yale University, in recognition of his work on oestrogens. The Bisset-Hawkins Medal has been conferred on Sir Frederick Menzies for his work as chief medical officer of the London County Council.

The honorary degree of doctor of science has been conferred by Tufts College on Dr. Charles H. Danforth, professor of anatomy at Stanford University. Dr. Danforth received the A.B. degree from Tufts College in 1908.

Dr. Samuel M. Feinberg, Chicago, has been elected an honorary member of the Argentine Society for the Study of Allergy.

Dr. Gerhard Domagk, professor of morbid anatomy at Münster, who first introduced prontosil, has been made an honorary member of the Spanish Academy of Dermatology and Syphilology.

Dr. William Harvey Perkins, professor of preventive medicine in the School of Medicine of Tulane University, has been appointed dean of Jefferson Medical College, Philadelphia. He succeeds the late Dr. Henry K. Mohler.

Dr. Jesse E. Hobson, of the Westinghouse Electric and Manufacturing Company, has been made director of the department of electrical engineering of the Illinois Institute of Technology at Chicago. The institute was formed last year by the consolidation of the Armour Institute and the Lewis Institute.

Assistant Professor M. E. Ensminger, of the Massachusetts State College, will become head of the department of animal husbandry of the State College of Washington at Pullman.

Anna M. Lute, seed analyst for the Colorado Agricultural Experiment Station, retired on September 1.

Rear Admiral W. H. P. Blandy, who has relieved Rear Admiral W. R. Furlong as chief of the Bureau of Ordnance of the Navy, has been named by the U. S. Navy Department as its representative on the Standards Council of the American Standards Association. Commander Alexander J. Couble, on duty in the Bureau of Ordnance, has relieved Commander F. T. Spellman, and has been named alternate for the chief of the Bureau of Ordnance on the Standards Council.

At the recent annual meeting of the Woods Hole Oceanographic Institution, Dr. Vannevar Bush, president of the Carnegie Institution of Washington, was elected a trustee to serve until 1944.

Dr. G. H. A. Clowes, research director of the Eli Lilly and Company; Dr. S. C. Brooks, professor of zoology of the University of California at Berkeley, and Columbus Iselin, director of the Oceanographic Institution at Woods Hole, have been elected trustees of the Corporation of the Marine Biological Laboratory at Woods Hole. Dr. W. H. V. Osterhout was elected trustee emeritus.

Carl F. Graham, head of the laboratory of the Procter and Gamble Manufacturing Company, Kansas City, has resigned to become head of the analytical section of the research department of the J. B. Ford Company, Wyandotte, Mich.

Dr. H. Ch. Dyme, of the Kraft Cheese Company, has joined the staff of the Afral Corporation of New York City.

At Columbia University A. Dejter Hinckley, assistant to the dean of the School of Engineering; Dr.

Charles O. Beckmann, assistant professor of chemistry; James L. Dohr, associate professor of accounting, and Dr. H. W. Farwell, professor of physics, have been appointed members of a committee to coordinate defense training in engineering, science and management.

DR. B. B. FREUD, chairman of the department of chemistry at the Illinois Institute of Technology, has been given a leave of absence for the coming academic year, to serve as colonel. He will be corps area liaison representative with the Sixth Regional Office of Civilian Defense.

SURGEON REAR-ADMIRAL G. GORDON-TAYLOR, vice-president of the Royal College of Surgeons, has been appointed a delegate of the college to attend the thirty-first annual Clinical Congress in Boston, as the guest of the American College of Surgeons.

DR. TRINO CASTRO, director of the Venezuelan Foundation to Combat Infantile Paralysis, arrived in New York on August 27 to attend the American Congress of Physical Therapy to be held in Washington. The foundation in Venezuela, which was recently established, is the first institution of the kind in South America.

DR. RALPH T. ST. JOHN-BROOKS, curator of the National Collection of Type Cultures at the Lister Institute, London, is spending a few months in studying the American Type Culture Collection at Georgetown University. He is investigating several taxonomic problems of joint interest to the two collections.

DR. MELVILLE J. HERSKOVITS sailed for Brazil on August 29, where he will continue his ethnological research during the coming year. The work has been made possible by a grant from the Rockefeller Foundation to Northwestern University. During his absence Dr. William R. Bascom will be acting chairman of the department of anthropology at Northwestern University. Herbert Passim has joined the staff as instructor.

*Industrial Standardisation* reports that Senor Patricio Plante, director of Talleres Metalurgicos at Buenos Aires, vice-president of Iram, the national standardizing body of Argentina, has returned home following a month's stay in the United States. During his visit he conferred at length with the American Standards Association in order to bring about closer cooperation between the two organizations. This cooperation includes an arrangement by which the American Standards Association will circulate standards of the Argentinian body in draft form to secure criticism from interested American industries before their formal adoption. Iram, the largest and oldest

standardizing body in Latin America, maintains for the use of Argentinian industries files of all the more important standards of the industrial countries of the world.

AN expedition to various parts of California to collect cryptogamic plants for the herbarium of Field Museum of Natural History recently left Chicago under the direction of Dr. Francis Drouet, curator of cryptogamic botany. Dr. Drouet was accompanied by Donald Richards, of the Hull Botanical Laboratory of the University of Chicago. Collecting will be continued until about the end of October. Several weeks will be spent in the northern mountainous counties, giving special attention to the algae and mosses of the region. A week will be devoted to collecting in the vicinity of San Francisco Bay to secure additional material of the numerous species of microscopic algae described from there in the past. The remainder of the time will be taken up with studies of the algal and moss flora of the San Joaquin and Imperial Valleys in the central and southern parts of the state.

IN the issue of *SCIENCE* of August 8, page 132, in the note giving an account of an expedition of the American Museum of Natural History, there is reference to a giant rodent which is incorrectly described. A correct account of the discovery of the remains of this rodent from the Oligocene is given in the article by Dr. George Gaylord Simpson, of the American Museum of Natural History, in the issue of *SCIENCE* for May 16.

NEEDS of the National Defense Program have caused the Civil Service Commission to announce an examination for junior meteorologist in positions paying \$2,000 a year. There were not enough eligibles obtained as a result of the written test given under the junior professional assistant examination early this year. Accordingly, applications for a new examination will be accepted until June 30, 1942. The examination will be of the unassembled type—that is, no written test will be given. Applications will be rated as soon as possible after they are received at the commission's Washington office, and those rated eligible will have their names placed on the register set up as a result of the written examination given for the junior meteorologist option of the 1941 junior professional assistant examination. Further information can be obtained from the U. S. Civil Service Commission, Washington, D. C.

THE *London Times* states that German raiders recently set fire to the library of the Moscow Academy of Sciences. The fire was put out, however, before any of the 3,000,000 valuable books in the library were destroyed.

THE Industrial Research Institute, which is affiliated with the National Research Council, will meet in De-

troit on September 26 and 27. The Hotel Statler has been designated as headquarters.

## DISCUSSION

### THE MAGNETIC CURRENT

Not only electric currents but also magnetic currents flow through the universe.

I reached this conclusion by consecutive and persistent observation of single submicroscopic particles suspended in gases.<sup>1</sup> Using this method in my small condenser I can measure forces of an order of magnitude down to  $10^{-10}$  dynes. Therefore my measurement of forces is more sensitive by the factor of  $10^4$  than any direct measurements of forces made so far. I was able to find new facts because methods of the highest possible sensitivity were used.

These observations can be summed up in two sentences:

(1) *Particles of matter, irradiated by a concentrated beam of light, move in a homogeneous electric as well as magnetic field in or against the lines of force.* (Electro-photophoresis, magneto-photophoresis). I have therefore concluded that these particles are charged under the impact of light. There exist not only electric but also magnetic charges.

(2) *Particles of the same kind and size move simultaneously toward and against the propagation of the light.* I called the movement away from the light lightpositive and that toward the light lightnegative longitudinal photophoresis.<sup>2</sup> I have therefore concluded that the light beam has potential differences along its propagation which cause the particles on which charges are induced to move in or against the direction of propagation. To the well-known oscillating fields in the beam of light have to be added these stationary electric and magnetic fields.

Before such fundamental conclusions can be drawn one must first see if there is no other explanation possible in accord with existing theories. Working for decades on the experiments and their interpretation I was forced to believe that only such an electromagnetic interpretation can be in accordance with all observable facts.

Heat or mechanical effects—so-called radiometer

forces (Crookes)—can not account for these phenomena for the following reasons: There is a photophoretic force in liquids which is of the same order of magnitude as in gases, although no radiometer forces exist in liquids. Silver or copper particles in gases which are reflecting strongly exhibit a tremendous lightnegative movement, though they ought to be most heated on the side toward the light, and one would expect a movement away from the light. It seems impossible to explain the reversibility of the particles with corresponding reversals of the field. The energy of the fields alone is responsible for the orientation of the particles and is a quadratic function of the potentials. One therefore should not expect a change of direction in the motion of uncharged particles if the field is reversed. Were the movement due to heating effects, one could not explain why the particles move across and along the inner part of the beam instead of going entirely out of it. It would also seem strange that the movement of nickel particles under the influence of the geomagnetic field, as it was observed in my institute in Vienna (Austria), could be compensated by a superposed magnetic field of about 0.4 gauss. Furthermore, the movement of the particles always follows the lines of force, no matter from which direction the light may come. This would be impossible if the movement were due to heating effects. That some particles start to move suddenly from rest, that the photophoretic movement suddenly disappears and sometimes increases or decreases gradually, and many other observations can not be explained by mechanical or heat effects.

When I came to the conclusion that there are single magnetic poles (magnetic charges), it was therefore not necessary to ask if this agreed with existing theories, but rather whether there are any experimental facts that contradict it. It can be stated here that so far there are no experimental facts which contradict this conclusion of the existence of single magnetic poles. A study of the literature made with Leo Banet showed the following situation:

It has been the predominating opinion up to the present time that a real quantity of positive or negative electricity can be enclosed within an arbitrarily chosen geometric surface. But no matter how the surface is chosen it will always enclose the same amount of south and north magnetism. In other words, there are true quantities of electricity of either

<sup>1</sup> F. Ehrenhaft, *Annalen der Physik*, 56: 81, 1918; *Philos. Mag.*, 11: 141, 1931; *Annales de Physique*, (Paris) 13: 151, 1940; *Phys. Rev.*, 57: 562 and 659, 1940; *Jour. Franklin Inst.*, 230, 381, 1940; *Nature*, 147: 25, January 4, 1941; F. Ehrenhaft and L. Banet, *Nature*, 147: 297, March 8, 1941; F. Ehrenhaft, *Philosophy of Science*, 8, No. 3, 1941, "The Microcoulomb Experiment" (charges smaller than the electronic charge), see p. 36; F. Ehrenhaft and Leo Banet, *Philosophy of Science*, 8, No. 3, 1941. The older references about photophoresis are given in *Annales de Physique*, 13: 151, 1940.

<sup>2</sup> I have recently constructed the apparatus on which the above-mentioned phenomena can be seen at C. Zeiss

Inc., New York. The latest descriptions of the apparatus and of the experiments are given in *Annales de Physique*, 13: 151, 1940.

sign, but no true magnetic ones. This statement has been made quite clearly by James Clerk Maxwell in his "Treatise on Electricity and Magnetism." Maxwell tried to prove that there was no such thing as true magnetism. May I remind you here that *in principio* it is impossible to prove from experiments that something is non-existent. Furthermore, the two experiments which Maxwell quotes are not conclusive. The first one states that a broken magnet gives two entire magnets with equal poles. If a non-magnetic piece of iron is broken, it can be observed that the fragments become magnetized in various ways on the broken ends. The effect is the same when a non-electrically charged glass or sulphur rod is broken, and shows at the ends various kinds of electric charges. This phenomenon is easily explained, since each breaking creates constriction. Each constriction, however, creates electricity and magnetism. The breaking experiment therefore, does not prove that true magnetism does not exist, as Maxwell stated.

The second experiment, which probably originated with the ancient Chinese and is quoted by P. Peregrinus (*anno* 1269), indicates that a magnet floating upon water directs itself but does not move. From this has been concluded that the amount of north and south magnetism is equal in each magnet. It is easy to perceive that the mobility of such a big floating magnet is much too small to show slight differences of charge. The particles on which my observations were made have a mobility a million times greater than that of the floating magnet of Peregrinus. Such particles irradiated with light move in a homogeneous magnetic field in the lines of force. Thus my sensitive experiment gives evidence of the existence of true magnetism. In other words, the Peregrini-Maxwell experiment turns out to be positive in my small condenser, when light is used.

My interpretation not only explains all observations in a rather simple manner, but also makes a number of new conclusions possible. One of these is that light magnetizes matter. Leo Banet and I succeeded in magnetizing small pieces of iron by means of irradiation with ultraviolet rays. Lilly Rona has expressed the idea that, concluding from these experiments, it should be possible to extract electricity from the beam of light originating from these stationary components. I believe that she is right, and that it could be done without the use of the photoelectric effect, that means without deteriorating and decomposing matter itself.

Under the influence of the light matter coagulates more readily because of the induced poles (charges). Sometimes the light separates amorphous and crystalline particles, and sometimes it makes crystals grow toward it (heliotropism of crystals).

Light causes irregularities in Brownian movement

and therefore also in diffusion because of photo-phoresis.

Light causes ponderomotive forces to act upon matter apart from the effects of the light pressure. These ponderomotive forces are produced by the stationary components and induced charges. The latter have attracting or repelling effects.

I determined the magnitude of the charge of the magnetic ion and found it to be of the same order of magnitude as the electric one.

A new phenomenon which I called the trembling effect found a simple explanation, the frequent change of the magnetic charge occurring predominantly in weak magnetic fields in the beam of light.

Leo Banet has drawn important conclusions in regard to the effects on the sun and the earth that will be described in another paper.

Now I shall say a few words about the *magnetic current*. We have shown the existence of unipolar magnetic charges, which flow in a homogeneous magnetic field in or against the direction of the lines of force. This can be observed directly by means of a microscope. Therefore we have to deal with magnetic currents in a physical and technical sense. Around a magnetic current there exists an electric field. Furthermore a magnetic current produces heat in a medium conducting magnetism.

I have attempted to show that a beam of light causes or induces not only heat and electricity but magnetism at the same time.

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#### EFFECT OF THYMUS EXTRACT INJECTIONS ON RATS

FOLLOWING the report of Rowntree and coworkers<sup>1</sup> on the marked precocity of development and growth resulting from daily peritoneal injections of thymus extract to successive generations of rats, an attempt was made to repeat these findings. Correspondence with Drs. Rowntree and Hanson regarding the preparation of the extract greatly facilitated our work. No positive findings were obtained by us, even after carrying the rats to the F<sub>4</sub> generation. This was not reported at the time because we felt that perhaps the calves from which the thymus glands were obtained were not of the age specified.

With the publication of a modified method for the preparation of the extract by Steinberg,<sup>2</sup> the work was repeated, using this method of preparing the extract. This time we had a source of supply from which we could definitely obtain thymus glands from calves of the type stressed: local stock, milk-fed, two

<sup>1</sup>L. G. Rowntree, J. H. Clark and A. M. Hanson, *Am. Jour. Physiol.*, 109: 90, 1934.

<sup>2</sup>A. Steinberg, *Endocrinology*, 23: 581, 1938.

to six weeks old. As before, the rats were carried to the  $F_4$  generation, with no positive findings resulting.

In both series of experiments, chemical findings for glutathione-like substances were always within the limits specified by the Philadelphia workers.

In connection with the above, it is well to note that negative findings in mice<sup>3</sup> and in rats<sup>4</sup> have been reported. Positive findings in rats have been reported from the Wistar Institute,<sup>5</sup> and positive findings regarding sexual maturity only in mice by Lafon.<sup>6</sup>

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### A NUCLEUS-LIKE STRUCTURE IN A STAPHYLOCOCCUS

IN the course of studies on the variability of bacteria, we encountered a greenish-black staphylococcus which spontaneously dissociates into a yellow form.

The resting cell of this staphylococcus contains a single granule, spherical or slightly ellipsoidal in form and located near the center of the cell.

The growing cell contains either a single rod-like granule parallel to the long axis of the cell, or two granules spherical or ellipsoidal in shape and lying in the polar regions across the long axis of the cell. Instead of being rod-like, the granule may often be kidney-like.

These granules have the following properties: (1) They are pseudo-chromotropic with old solutions of methylene blue. (2) They are strongly acidic, staining deeply with methylene blue at pH 1.8-2.0. (3) They are not dissolved in 10 minutes by boiling water. (4) They are not dissolved by 0.02-0.5 per cent. sodium bicarbonate after a contact of over two hours. (5) They do not disappear when the cells are subjected to starvation for as long as 24 hours at 37° C. (6) They do not disappear upon frequent transferring. (7) They give a clear-cut Feulgen reaction under all the conditions listed above.

The constancy of these granules, their position, numbers and morphology in resting and growing cells, added to the properties enumerated above, speak strongly for their nuclear nature. Indeed they appear to fulfil all the requirements of nuclei.

The size of these granules, compared to that of the cell, is strikingly large, and yet we have been so far unsuccessful in our attempts at observation in the liv-

ing cell, indicating that, in the living state, their refractive index is close to that of the cytoplasm.

We were unable to detect any type of reserve material in the cell of the staphylococcus.

The details and records of the present work will be published elsewhere.

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### HOW MANY SPECIES OF PLANTS ARE THERE?

RECENTLY, during the course of investigations of general systematics of plants, it has been noted that current text-books of botany for university students contain discrepant and often contradictory statements of the number of existing species of Angiosperms. For example, according to a dozen books examined, the number of species of all Angiosperms varies from 133,000 to 175,000; of Dicotyledons 100,000 to 140,000; and of Monocotyledons 24,000 to 35,000. The number of Gymnosperms usually is said to be 500, and the total of all living species of plants is frequently estimated to be about 250,000. The methods used by the authors of these books in obtaining these figures is not revealed, but it is clear that the relatively simple expedient of consulting reasonably accurate recent sources of taxonomic data was not employed.

It occurred to me, therefore, that, in view of the fact that these estimates appear to have been based upon antiquated data, it may be worthwhile to present a more accurate summary. According to a compilation made partly from the eleventh edition (1936) of "Die Syllabus der Pflanzenfamilien" (Engler and Diels), and partly from recent monographs and other sources, the Angiosperms contain a total of 195,000 known species; of these, 155,000 are Dicotyledons, and 40,000 are Monocotyledons. There are approximately 640 species of Gymnosperms. On the basis of figures supplied by G. M. Smith,<sup>1</sup> there are (with the addition of Bacteria) 107,570 species of Thallophyta and 23,000 species of Bryophyta. The Pteridophyta contain about 10,000 species, of which 9,000 belong to the Filicales.<sup>2</sup>

Thus, the conclusion may be drawn, that on a conservative basis, the approximate total number of different species of known living plants is slightly in excess of 335,000. The rate of discovery and description of new species of flowering plants during the twenty-five year period from 1910 to 1935 has been reported by E. D. Merrill as averaging at least 4,800 per year.<sup>3</sup>

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<sup>1</sup> "Cryptogamic Botany," Vol. 1, 1938, McGraw-Hill Book Co.

<sup>2</sup> C. Christensen in Verdoorn's "Manual of Pteridology," The Hague, 1938.

<sup>3</sup> *Memoirs Brooklyn Botanic Garden*, 4: 57-70, 1935.

<sup>3</sup> G. van S. Smith and E. E. Jones, *Proc. Soc. Exp. Biol. and Med.*, 43: 157, 1940.

<sup>4</sup> H. B. Vickery, Carnegie Inst. Wash. Year Book No. 37, 335, 1937-8; H. Chiodi, *Rev. de la Soc. Argent. de Biol.*, 14: 826, 1938; W. O. Nelson and D. A. McGinty, quoted by Nelson in "Sex and Internal Secretions," 2nd Edition, 1939, Chapter XXI.

<sup>5</sup> *Wistar Institute News Letter*, April 15, 1936.

<sup>6</sup> M. Lafon, *Jour. Exp. Biol.*, 13: 140, 1936.

## QUOTATIONS

### THE GIANT CYCLOTRON<sup>1</sup>

WITH so much creative human talent employed in devising increasingly powerful engines of destruction it is at least some comfort to know that to-day in the United States work is proceeding on two of the mightiest instruments the world has seen for the peaceful exploration of the universe. One is the 200-inch telescope nearing completion on Mount Palomar, California; the other is the giant cyclotron under construction at Berkeley, California. The new telescope will explore the outer reaches of the universe, the realm of the infinite; the new cyclotron will probe the inner reaches of the universe, the realm of the infinitesimal. The telescope was made possible by an appropriation in 1928 of \$6,000,000 by the International Education Board, established by Mr. John D. Rockefeller, Jr. This last year the Foundation appropriated \$1,150,000 to the University of California for the construction and housing of the cyclotron.

From the time of Democritus, the natural philosopher has tried to probe inside the matter of which our physical universe is built in order to discover the nature of its smallest parts and the laws which govern them. For centuries there could be nothing but vague speculation, for suitable experimental procedures were not available. But brilliant advances have been made since the turn of the present century, and in forty years of research a flood of light has been thrown on the nature of atomic structure. Two decades ago this inner citadel of the universe was successfully attacked by shooting into the atom small projectiles of such high speed that they disrupt the internal pattern. Then from a study of the erupted fragments, of the mutilated remainder, and of the battered projectile, new knowledge was obtained of the atom's structure.

The most successful device for this purpose has been the cyclotron, invented by Professor Ernest O. Lawrence, of the University of California. In essence the cyclotron is a machine for imparting extremely high velocities to atomic particles by means of electrical impulses. The particles, which are the bullets of the gun, are charged atoms. Whirling in ever-widening circles in a chamber mounted between the poles of an immense magnet, these particles are sped faster and faster by alternate changes of an electrical field from negative to positive and vice versa until they are finally shot out through an opening to smash against a target whose atoms are to be cracked by their impact. It is as if a stone were whirled on the end of an elastic cord in a constantly enlarging orbit

until at last it flies off at a tangent with tremendous force. When these bullets emerge from the cyclotron they are in the form of a steady beam, moving at velocities which may exceed 100,000 miles a second. At such high speeds they constitute the most powerful concentrations of energy ever controlled by man.

There are now in operation throughout the world some thirty-five cyclotrons of varying sizes. Of these, twenty-four were either built by, or are now being operated by, men who were trained in Lawrence's laboratory. Lawrence himself has built a sequence of cyclotrons of increasing size, varying in weight from 500 pounds to some 220 tons, and producing a beam ranging from 80,000 volts in his smallest cyclotron to 16,000,000 volts in his largest. The new giant cyclotron will contain over 4,000 tons of steel and copper in its magnet alone and will produce a beam whose voltage will range from 100,000,000 to perhaps 300,000,000. The beam of the largest cyclotron now operating penetrates, in air, about five feet; the beam of this giant instrument will penetrate 140 feet.

But of what use is this machine and what can it do for man? The chief practical application to date has been in the use of the beam to produce radioactive matter. The new array of radioactive substances which has resulted will almost surely have an important relationship to current scientific problems; but one broad field of application has already been clearly demonstrated: these artificially radioactive atoms are the familiar "tagged atoms" which are now being used in chemical, biochemical, physiological and other laboratories all over the world in a wide range of basic research which would be quite impossible were it not for this unique new material.

Furthermore, the beam of exceedingly high-speed particles can be applied, like x-rays, gamma rays, and other types of radiation, directly to living organisms, and the effects can be analyzed and ultimately utilized. It will require years to investigate the efficacy of beams of different composition and intensities on various vital processes; but experiments have already shown, for example, that beams of neutrons can penetrate deeply into living tissue and can there release local radiations which can be, but need not be, intense enough to kill cells. These further applications are now in their first tentative stages. It is as difficult to predict the exact nature of their use as it would have been in the case of x-rays at a similar point in their development.

But if these results are being obtained by cyclotrons now in existence, why build this new giant machine? The answer takes us into the field of ex-

<sup>1</sup> From the President's Review of the work of the Rockefeller Foundation for 1940. Raymond B. Foadick.

ploration and the insatiable intellectual curiosity which is the mark of civilized man. The most powerful cyclotrons now in existence produce particles whose speeds, when fired at atoms, enable them to knock off only the external and more loosely bound features of the atoms under attack. It is at this point that the new giant cyclotron, now under construction, is of critical importance, for it is designed to produce projectiles so powerful that they can penetrate and explore the nucleus itself.

It is essential to realize the significance of this point. During the last forty years, science has learned much about atomic structure. One outstanding mystery, however, remains, and in many senses it is the major mystery. Relatively little is known about the nucleus, the central core of the atom. There is evidence that this nucleus possesses a discoverable structure, that it is formed of certain elementary units in accordance with laws with which we are not familiar; and physicists to-day consider its investigation the most important present problem in physical science. Here in the interior of the nucleus is the one essentially unexplored part of our universe. It is a world into which we have hitherto been powerless to enter; and the urge to penetrate, to explore and to analyze is irresistible.

This urge, moreover, is heightened and justified by

the conviction that this virgin territory will prove to be rich. Practically all the energy of the atom, for instance, is stored within the nucleus; and it is the nucleus which really determines the character of an atom and is hence ultimately responsible for all the properties of matter. Furthermore, there is evidence that the essential forces which bind the nucleus together are due to an elementary particle called a "mesotron." These same mesotrons play an important rôle in cosmic rays; and if more could be learned about mesotrons it would immediately throw light not only on this other perplexing problem, but on still further riddles with which science is now grappling on the frontiers of knowledge.

The real case for building a great cyclotron rests upon its ability to make accessible a new infinitesimal world—the interior of atomic nuclei, with all the possibilities of fresh knowledge that may there reside. It is an adventure in pure discovery, motivated by the unconquerable exploring urge within the mind of man.

In this sense, therefore, the new cyclotron is more than an instrument of research. Like the 200-inch telescope it is a mighty symbol, a token of man's hunger for knowledge, an emblem of the undiscourageable search for truth which is the noblest expression of the human spirit.

## SCIENTIFIC BOOKS

### HUMAN NATURE

*Human Nature and the Social Order.* By E. L. THORNDIKE. xx + 1019. Macmillan. 1940.

THIS book is of monumental proportions with its half million words and weight of nearly 3½ pounds. Because of its forbidding size it lay on my desk for weeks before I could muster courage to tackle it. Once started, however, I read the book from cover to cover with unflagging interest in the contents and with many chuckles over the author's way of putting things. My chief complaint is that it was not published as two volumes instead of one, so that it could be read by the nearsighted with less fatigue of the arms and shoulders.

The material is divided into 38 chapters and 6 appendices. Part I (400 pages) deals with such topics as the ABC of behavior, human abilities, wants and their measurement, mental dynamics, individual differences, the roles of nature and nurture, conflicts of wants and the evaluation of satisfactions. Among the leading problems treated in Part II are the science of philanthropy, the welfare of future men (eugenics), the welfare of the present, utility and disutility, natural resources and capital, labor and management,

buying and selling, payment for human factors, money and credit, ownership, the psychology of capitalism, political science, human relations, criteria of a good government, rulers and methods of ruling, the aims of government, human nature and the law, the improvement of law, human nature and reform.

A statement in the preface says that the book is intended not only for college students of the social sciences but also for thinking men and women generally. In my judgment it will be useful and stimulating to both groups despite the fact that it is neither a systematic treatise on social psychology nor an all-round introduction to the social sciences. Part I is an exposition of the facts and principles of psychology which the author considers most important for the social science student. Here 75 pages are devoted to abilities, 55 to individual differences, 125 to wants and mental dynamics, 57 to heredity and environment and 50 to evaluation of satisfactions. In these sections the author draws extensively upon his earlier books, but there is much new material and the old is effectively reorganized and freshly stated. Part I presents a large amount of psychological information of the kind social scientists most need but get little of from the average text-book in social psychology. The

emphasis upon abilities, wants, individual differences and genetic factors sets the tone for the entire volume. The treatment is factual and realistic with a profusion of concrete illustrations expressed in striking (sometimes bizarre) word pictures. In places, however, it is not easy reading. Many of the concepts and distinctions that probably seem to the author quite elementary will present difficulties even for the superior student who has not had considerable course work in psychology and statistical methods. There are occasional passages that would have benefited from greater attention to clarity of statement. Outstanding qualities of the author's style are vigor, originality and pungency.

Part I and Part II are essentially quite different. Part I is psychological throughout and is concerned almost exclusively with fields in which the author himself has made research contributions of high merit. Part II (600 pages) is not to any great degree psychological but gives the author's personal reactions on a vast miscellanea of problems in economics, political science and social welfare. The discussion of these problems, which lie so largely outside the realm of present-day psychological science, is rightly intended to emphasize the extent to which their solutions must take account of psychological phenomena. On a good many of the issues discussed in Part II the psychologist, as psychologist, can at present make little or no contribution. Some of the discussions could as well have been written by a mathematician, chemist, biologist or lawyer. What Thorndike has to say is nearly always thought-provoking, whether he speaks primarily as psychologist or not, but it is probably these excursions into alien territory that will draw the most criticism.

I estimate that nearly 20 per cent. of Part II is taken up by quotations, often long ones, from many authors. The quotations are apropos and usually interesting but distract somewhat from the unity of treatment. Part II in general is likely to impress the reader as having less organization than would have been desirable.

I have stated above that this book "is neither a systematic treatise on social psychology nor an all-round introduction to the social sciences." Numerous topics which bulk large in the average text in social psychology are omitted or only casually mentioned. For information on relative emphasis it is instructive, even if sometimes perhaps misleading, to compare the index of a book with that of another in the same general field. I have made some comparisons of this kind between Thorndike's book and Kimball Young's "Social Psychology."<sup>1</sup> The figures that follow show for selected topics the number of references to each in the

subject indexes. The first figure in each pair is for Thorndike, the second for Young.

More frequent mention by Thorndike:

Abilities (or intelligence)	14-4
Capital (or capitalism)	10-1
Genes (or heredity)	25-3
Individual differences	21-10
Mastery	11-0
Measurement	12-0
Needs (or wants)	17-0
Prediction	7-0
Rewards	11-0
Rulers (or ruled)	4-0
Russia (or Soviet)	14-0
Satisfactions	12-0
Tests	8-0
Wealth	6-0

More frequent mention by Young:

Attitudes	6-24
Censorship	1-37
Conditioning	2-9
Crowd	0-31
Cultures	0-30
Emotions	0-25
Fads (or fashions)	1-37
Gangs	0-4
Interaction	0-7
Language	0-30
Laughter	0-8
Leadership	0-37
Legends (or myths)	0-18
Newspapers	0-29
Personality	2-30
Play	1-13
Prejudice	0-35
Stereotypes	0-21
Propaganda	3-40
Public opinion	0-32

Examination of the name indexes discloses similarly striking contrasts even when the comparison is limited to names of writers who have dealt with social issues. The following figures (again in the T-Y order) are more or less typical:

F. Allport	2-15
Bentham	7-0
Burgess	0-7
Cooley	0-7
Dewey	1-11
Freud	3-11
Holmes (Justice)	7-0
McDougall	1-14
W. I. Thomas	2-16
E. A. Ross	0-9
Sumner	0-7
Veblen	14-9
G. Wallis	7-2
Webb (B. or S.)	12-0

The figures just given make it clear that this book

<sup>1</sup> Knopf, 1930, pp. 38 + 674.

is not just another text in social psychology. For the most part it leaves the concepts and problems of sociology to the sociologists, especially the problems of acculturation and human interaction. Its most distinctive contribution is in the emphasis placed upon the social significance of individual differences in abilities, character, wants and satisfactions, and upon the genetic causes of such differences. Thorndike does not deny the importance of good environment, but he never forgets that genes set the limits to its effects. With sly humor he notes that "the perfectibility of human nature is wisely put by religions in a heaven with not only optimal environment but also infinite time." Numerous passages could be cited in which he pays his respects to the biological ignorance that underlies egalitarian social philosophies. Certainly very few writers have so boldly expressed the implications (as he sees them) of the doctrine of individual differences for economic and political theory.

Not every one will agree with Thorndike on what the true implications are. Some who agree with him completely about the potency of genes will be unable to accept all the conclusions he deduces from that

premise. For Thorndike the fact that the ability of the gifted far transcends that of the masses, together with the fact that there is a positive correlation between ability and character, calls for a political system in which power would be largely concentrated in the hands of a benevolent aristocracy composed of the able and the good and in which equal suffrage would be replaced by some scheme of weighted ballots. The author believes that our present "aversion to government by experts is on a level with aversion to medical treatment or sanitation by experts." One may question whether he has given due consideration to the dangers inherent in even the best aristocracies and whether he is not banking too heavily on the practical consequences of a slight positive correlation between intelligence and character. It may well be, however, that a vigorous presentation of this point of view will serve as a useful antidote to the sentimental political and social philosophies that ignore or deny heredity differences and attribute magic influences to factors of environment.

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## SPECIAL ARTICLES

### FAILURE OF BARLEY TO FIX MOLECULAR $N^{15}$

THE testimony of centuries of experience in practical agriculture has established the respective nitrogen depleting and nitrogen replenishing natures of non-leguminous and leguminous crops. Despite the weight of practical and experimental evidence against the conclusion, periodic reports reassert that non-leguminous plants can fix atmospheric nitrogen.

Results were presented in this journal by Ruben, Hassid and Kamen<sup>1</sup> indicating the fixation of radioactive  $N^{15}$  gas by the fresh tops of barley plants and the lack of fixation by tops boiled in water before exposure to  $N^{15}$ . As  $N^{15}$  has a half life of but 10.5 minutes, these experiments were necessarily of very short duration, the barley tops having been exposed to  $N^{15}$  for only 20 minutes.

The stable nitrogen isotope,  $N^{14}$ , offered us a means of tracing nitrogen fixation without the time limitation imposed by the radioactive isotope. Barley seeds were dehulled and then rendered bacteria-free by treatment with 70 per cent. ethyl alcohol followed by calcium hypochlorite solution carrying 3 per cent. available chlorine. The seeds were germinated aseptically and transferred to culture tubes containing thoroughly washed quartz sand to which a nitrogen-free nutrient salts solution had been added prior to sterili-

zation. Tubes containing bacteria-free red clover plants and red clover plants with added root nodule bacteria (*Rhizobium trifolii*) were prepared in the same manner. Cresol red<sup>2</sup> in side bulbs on the tubes indicated when  $CO_2$  was needed, and this gas was added to the atmosphere as required during the experiment. The plant culture tubes were sealed to a common manifold, evacuated and supplied with a gas mixture of 20 per cent. oxygen and 80 per cent. nitrogen. The nitrogen gas had 13.5 atom per cent.  $N^{15}$  excess (i.e., 13.87 per cent.  $N^{15}$ , the normal abundance of  $N^{15}$  being 0.37 per cent.) and was freed of combined nitrogen compounds by passage through alkaline  $KMnO_4$  and  $H_2SO_4$ .

Each group of plants, bacteria-free barley, bacteria-free clover and inoculated clover, received the same gas mixture, and the gas during the entire experiment was free to diffuse among the tubes through their cotton plugs. Air controls were grown in the same manner. The plants of experiment 1 were harvested after 42 days, subjected to Kjeldahl digestion, the  $NH_3$  distilled and then converted to  $N_2$  with alkaline hypobromite.<sup>3</sup> The  $N_2$  was analyzed for the  $N^{15}$  isotope with a mass spectrometer.

In a second experiment, which did not include the bacteria-free clover culture, 8.1 atom per cent. excess

<sup>2</sup> Elizabeth M. Smyth, *SCIENCE*, 80: 224, 1934.

<sup>3</sup> D. Rittenberg, A. S. Keston, F. Rosebury and R. Schoenheimer, *Jour. Biol. Chem.*, 127: 291, 1939.

<sup>1</sup> S. Ruben, W. Z. Hassid and M. D. Kamen, *SCIENCE*, 91: 578, 1940.

$N^{15}$  nitrogen gas was used. The plants were harvested after 56 days and analyzed. The experimental results are given in Table 1 as atom per cent.  $N^{15}$  excess of plants over the average values of air control plants.

TABLE 1

	Atom per cent. $N^{15}$ excess of plants over average of air controls	
	Exp. 1	Exp. 2
Bacteria-free barley . . . .	$-0.010 \pm 0.005^*$	$-0.006 \pm 0.005$
Bacteria-free clover . . . .	$-0.004 \pm 0.005$	
Inoculated clover . . . . .	$2.469 \pm 0.061$	$0.689 \pm 0.052$

\* 0.005 per cent. represents the standard deviation of spectrometer readings for all determinations on the bacteria-free plants; the standard deviations of readings for the inoculated clover (calculated for individual samples) are higher, since the error of measurement is greater at higher  $N^{15}$  concentrations. The regular occurrence of negative values for bacteria-free plants is merely fortuitous.

These data show that if either barley or bacteria-free clover fixed any nitrogen, the amount fixed was within experimental error, whereas fixation by inoculated clover resulted in the accumulation of large quantities of  $N^{15}$ .

By calculation from the data of Ruben *et al.*,<sup>1</sup> we can find if their success and our failure to observe fixation arises from a difference in the sensitivity of the stable and radioactive tracer methods. These investigators used 30 grams wet weight of barley tops which, assuming 75 per cent. moisture and 3 per cent. nitrogen on a dry weight basis, would contain about 225 mg of nitrogen. The authors stated that during the experiment the plants assimilated an amount of  $N_2$  which "corresponds roughly to 0.01 cc of  $N_2$ "; 0.01 cc of  $N_2$  (0.0125 mg  $N_2$ ) constitutes 0.00556 per cent. of the total nitrogen of the plants. We can calculate what the final  $N^{15}$  content of our barley plants should be if we assume that the rate of fixation reported by Ruben *et al.*<sup>1</sup> occurred uniformly during the period of our experiment 1. Since 42 days' exposure is 3,024 times the 20-minute treatment of Ruben *et al.*,<sup>1</sup> 16.8 per cent. (i.e., 0.00556 per cent.  $\times$  3,024) of the total nitrogen of the plants would be fixed during the experimental period. But as 13.5 atom per cent. excess  $N^{15}$  was used, the observed  $N^{15}$  value would be 2.27 atom per cent.  $N^{15}$  excess (i.e., 16.8 per cent.  $\times$  0.135).

The value 2.27 atom per cent.  $N^{15}$  excess, which we would have found had our barley plants fixed nitrogen at the same rate as Ruben *et al.*<sup>1</sup> report for  $N^{15}$  fixation, is 454 times the standard deviation of our measurements with the mass spectrometer. It is about the same value as we actually observed with inoculated clover plants.

Since the fixation experiments with barley were completely negative, one can but speculate as to the reason that the twenty-minute exposure of excised barley tops in the experiments of Ruben *et al.*<sup>1</sup> resulted in an uptake of  $N^{15}$ . These workers extracted the barley

plants with boiling 80 per cent. ethyl alcohol, boiled the extract in a stream of air in an effort to drive off  $N_2$ , and then detected radioactivity in the boiled extract. It hardly seems likely that the observed  $N^{15}$  uptake can be attributed to fixation by the small number of bacteria carried by the plant tops or, in view of our results, to a true nitrogen fixation by the plant tops themselves. Ruben *et al.*<sup>1</sup> state, "These experiments with  $N^{15}$  do not necessarily prove that a net uptake of  $N_2$  has occurred, since the existence of reversible (interchange) reactions involving  $N_2$  is possible." However, Burris and Miller<sup>4</sup> demonstrated the absence of any interchange reaction in *Azotobacter vinelandii*, which was vigorously fixing  $N_2$  in a non-equilibrium  $N^{15}$ -excess atmosphere. The possibility remains that a non-specific surface adsorption of  $N_2$  by fresh barley tops and a failure to completely remove this  $N_2$  containing  $N^{15}$  accounts for the radioactivity detected by Ruben *et al.*<sup>1</sup> In our experiments it is obvious that the Kjeldahl treatment would eliminate all adsorbed  $N_2$ .

The complete lack of fixation of the stable  $N^{15}$  isotope by bacteria-free barley and bacteria-free red clover plants under conditions identical with those supporting active fixation of  $N^{15}$  by red clover inoculated with *R. trifolii* supports the generally accepted conclusion that non-leguminous plants and leguminous plants in the absence of the root-nodule bacteria are unable to fix molecular nitrogen.

In addition to the question of nitrogen fixation by non-leguminous plants, positive and negative reports in the literature present controversies concerning the nitrogen fixing ability of germinating pea seeds, excised root nodules with added oxalacetic acid, and root nodule bacteria in the absence of the host plant. Thus far we have been unable to demonstrate fixation of  $N^{15}$  by any of these biological agents, whereas azotobacter and leguminous plants with root nodule bacteria fix  $N^{15}$  readily.

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#### CROWN GALL PRODUCTION BY BACTERIA-FREE TUMOR TISSUES

Crown gall has in the past been produced only by inoculation of a host plant with *Phytoplasma tumefaciens* (Smith and Town.) Bergey *et al.* either as a pure culture or in the form of a preparation of tissues infected therewith. Although crown-gall tissues have not always yielded cultures of the organism, it has been presumed that the bacteria were present or at least had been present at some stage in the development of the tumor. The production of tumors with-

<sup>4</sup> R. H. Burris and C. E. Miller, *Science*, 93: 114, 1941.

<sup>5</sup> National Research Council fellow.

out direct stimulation from the bacteria, although envisioned as a possibility by certain workers, has not previously been demonstrated, nor has that possibility been given serious credence by other investigators.

One of us has recently confirmed the work of Smith *et al.*,<sup>1</sup> showing that true secondary tumors developed in sunflower plants at a distance of several internodes from the site of the primary tumor, even when inoculations were made into fully elongated internodes at a distance from the apical bud.<sup>2</sup> Many of the secondary tumors were found to be sterile by the usual bacteriological criteria. The bacteria-free secondary tumors appeared, therefore, to be admirably suited for an experimental study of the question as to whether host cells under the influence of the bacteria acquire the capacity for autonomous growth.

Recently developed techniques for the *in vitro* cultivation of excised plant tissues<sup>3</sup> were applied to the study of secondary tumors. Tissue fragments from the interior of a series of such tumors were removed aseptically and placed in 125 ml Erlenmeyer flasks, each containing 50 ml of White's standard glycine-thiamin nutrient<sup>4</sup> stiffened with 0.6 per cent. of thoroughly leached agar. Out of 107 original isolations from tumors, 2 were contaminated with bacteria and 4 with molds. Out of 50 control cultures taken from healthy plants, 4 were contaminated with bacteria and 3 with molds. The larger tissue masses available in the tumors and the consequent greater ease of manipulation were doubtless responsible for the lower incidence of contaminations in tumor cultures.

Cultures capable of continued rapid growth were not established from any of the small petiolar tumors nor from the petioles of healthy plants. On the other hand, out of 37 isolations from large secondary tumors from the stems at nodes, 19 grew successfully. Six isolations were carried through 3 or more passages, being divided at each passage. Two strains, one isolated on February 10, 1941, the other on March 25, 1941, were retained for detailed study. The first of these isolations has, at the time of writing (August, 1941), been maintained through 13 successive passages, has been divided into 482 pieces, each several times as large as the original, and has undergone a theoretical increase<sup>5, 6</sup> in volume of approximately 450,000 times. Throughout this manipulation, it has been constantly in contact, both at intact and at freshly cut surfaces, with a nutrient shown by ourselves and by others to be capable of supporting a profuse growth

of *Phytoplasma tumefaciens*; yet, out of the 482 cultures not a single one has developed any bacterial growth. Attempts to isolate bacteria from these cultures by grinding and plating on nutrient agar or in broth have consistently failed. When cultures were ground and the paste injected into sunflower or tomato plants, no galls were produced such as regularly appeared when a paste prepared in a similar manner from young primary tumors was injected. The results seem to furnish almost unquestionable evidence that these tissues, which multiply rapidly, nevertheless do so without continued stimulation from crown-gall bacteria. Their capacity for autonomous growth appears established.

Tumor tissues grown *in vitro* are colorless or, especially just after being divided, slightly tinged with brown from oxidative products, scattered remnants of dead cells, etc. The surfaces are rough, covered with irregular unorganized protuberances, and may put forth unorganized outgrowths either along the agar or up into the air. They are firm but easily cut and of uniform texture. Histologically they are mostly parenchymatous with scattered scalariform elements. These elements form a structure closely resembling that of crown-gall tissue stimulated by *Phytoplasma tumefaciens* when inoculated into parenchymatous tissues of the host.

Tissues from cambial and procambial regions of healthy sunflowers have likewise been isolated in culture but present a very different picture. In the 9 weeks that they have been maintained, they have been carried through 5 passages, but their growth rate has been so slow that the volume increase during this period has been of the order of 30 times as compared to about 400 times for the gall tissues over a corresponding period. Cultures of normal tissue maintain their outlines, whereas gall cultures grow as irregular or subglobular masses. Normal tissue cultures regularly contain chlorophyll, are woody in texture and frequently produce roots, a phenomenon not observed to date in cultures of gall tissues.

At the end of 5 successive passages *in vitro*, 10 tumor cultures were grafted back into young healthy sunflower plants. Of these, 5 implants had, at the end of 7 weeks, grown into typical crown-gall tumors having diameters up to 1 cm, one plant was accidentally broken, and 4 implants failed to grow. Similar results have been obtained with a second series of grafts using cultures from the 6th passage and a third series using cultures from the 10th passage. Attempts to isolate bacteria from one of the tumors by grinding and plating in nutrient dextrose agar failed. The results seem to indicate that the tumor-inducing capacity has been retained by these bacteria-free tissues through at least 10 successive passages *in*

<sup>1</sup> E. F. Smith, N. A. Brown and L. McCulloch, *U. S. Dept. Agr., Bur. Pl. Ind., Bull.* 255, 1912.

<sup>2</sup> A. C. Brown, *Phytopath.*, 31: 135-149, 1941.

<sup>3</sup> P. B. White, *Am. Jour. Bot.*, 26: 59-64, 1939.

<sup>4</sup> P. B. White, *Plant Physiol.*, 14: 527-538, 1939.

<sup>5</sup> P. B. White, *Plant Physiol.*, 9: 585-600, 1934.

*vitro*. Preliminary examination has shown the induced tumors to have a histological structure considerably more uniform than that of most crown galls, with extensive hyperplasia but relatively little disorganization. This last feature is quite marked and may possibly be due to the uniform distribution of the mechanism of hyperplasia in contrast to the scattered and localized centers of stimulus characteristic of bacterial galls. Fusion with the host tissue was excellent, although growth was mostly if not entirely a function of the transplant, as is the case with transplanted animal neoplasms. It is clear from these results that the affected tissues have undergone a drastic change which is indicated, first, by their capacity to produce

galls, a quality not found in normal tissue, and, second, by their behavior *in vitro*, where their growth habits differ markedly from those of normal tissues under identical conditions. That this change was originally brought about by some stimulus from the crown gall organism seems clear. That its maintenance is not dependent on the continued presence of the bacteria is equally clear. Further details will be published elsewhere.

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## SCIENTIFIC APPARATUS AND LABORATORY METHODS

### COLLODION FIXATION: A NEW IMMUNOLOGICAL REACTION

THE study of filterable viruses and of diseases caused by them is handicapped by the relative lack of *in vitro* reactions which can detect very small amounts of virus substance. The present dependence on pathological processes for the identification of viruses involves a considerable time factor. As an approach to the solution of these difficulties experiments were undertaken with a well-known immunological system in an effort to increase sensitivity, since this would appear to be the first requirement of any new method. The system employed was the reaction between antipneumococcus serum and the specific capsular polysaccharide of the pneumococcus. Under optimum conditions, specific precipitin reactions can be obtained with polysaccharide dilutions as high as 1-5,000,000; with complement fixation to 1-20,000,000.

The first series of experiments involved the adsorption of antibody on the surface of collodion particles, thereby artificially increasing the size of the antibody. Many workers have adsorbed antigen on collodion or other particles (*cf.* review by Cannon and Marshall<sup>1</sup>) and have demonstrated increased sensitivity as regards detection of antibody. Cannon and Marshall<sup>1</sup> sensitized collodion pellets with egg albumin; Weir<sup>2</sup> used tuberculin sensitized pellets for the study of antibody formation in animals. Our experiments in the adsorption of antibody were successful under very limited conditions; the most fortunate results were obtained with the use of purified horse and rabbit antipneumococcus sera. Particles so sensitized were agglutinated in the presence of the specific capsular polysaccharide in dilutions of approximately 10<sup>-10</sup>. The details of

these experiments will be published elsewhere. It may be said, however, that these systems are very sensitive to non-specific factors, such as broth, proteins, changes in electrolyte concentration, etc., and hence are not suitable for the general purposes of the method most desired.

In an approach to a more satisfactory method it was recalled that although both antigens and antibodies are not remarkable for adsorptive phenomena, the antigen-antibody complex is extraordinary in this respect: the complement fixation reaction is an example of this property.<sup>3</sup> Experiments were therefore undertaken to learn whether the antigen-antibody complex would adsorb collodion particles, thus, as it were, magnifying immunological reactions.

Collodion particles were prepared after the method of Cannon and Marshall,<sup>1</sup> the stock suspension being adjusted to a density such that a 1-10 dilution would match number 3 on the McFarland scale.<sup>4</sup> Suitable and constant quantities of collodion suspension are added to varying amounts of antigen in agglutination tubes. To these mixtures are then added appropriate amounts of immune sera; the total volume is then brought to 1.0 cc by the addition of physiological saline. With systems of some refinement, such as that with antipneumococcus serum, the tubes remain at room temperature for one hour and are then centrifuged for 5 minutes at 500 r.p.m. Each tube is "flipped" and the amount of particulate agglutination estimated. Control tubes, not containing antigen, give free and smooth resuspension. With less refined systems, such as the viruses, the tubes are placed in the icebox overnight, then centrifuged and read. An example of results obtained with the antipneumococcus system is given in Table I.

These results present two important points: (a) The

<sup>1</sup> P. R. Cannon and C. E. Marshall, *Jour. Immunol.*, 38: 365, 1940.

<sup>2</sup> J. M. Weir, *Proc. Soc. Exper. Biol. and Med.*, 46: 47, 1941.

<sup>3</sup> K. Goodner and F. L. Horsfall, Jr., *Jour. Exper. Med.*, 64: 201, 1936.

<sup>4</sup> J. McFarland, *Jour. Am. Med. Assn.*, 49: 1176, 1907.

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- TULKEN, LAWRENCE F. and others. *Test It Yourself!*. Pp. vi + 290. Illustrated. Scott, Foresman. \$0.96.
- VON LAUE, M. *Physik und Chemie in Einzeldarstellungen. Band VI, Röntgenstrahl-Interferenzen*. Pp. viii + 367. 120 figures. Akademische Verlagsgesellschaft, Leipzig. RM. 32.

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## SOME SOCIAL IMPLICATIONS OF THE SCIENTIFIC METHOD<sup>1</sup>

By Professor L. H. MacDANIELS

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SEVERAL considerations have led me to choose the present title, which I know will appear to many of you, at least at first sight, to be rather inappropriate for presentation before the American Society for Horticultural Science. Among these is the fact that our society is becoming mature. Attendance is now larger and more varied than formerly, and it seems not out of place to consider matters of a general nature rather than to continue the technical discussions of the regular sessions. Not that we should be less zealous of the pursuit of scientific knowledge, but

rather that now we have established our position as a first-class scientific society we can pause momentarily and examine our situation with relation not only to other scientific societies, but to the whole field of knowledge as well.

The subject is certainly timely. With most of the world at war or near war it is all too obvious that our control of physical forces has far outstripped the capacity or at least the will of the human race to manage their affairs in a satisfactory way. Such a statement is trite in view of the many efforts now being made to increase the sense of responsibility among the scientists for the social order. This trend has been emphasized recently by the National Research

<sup>1</sup> Address of the president of the American Society for Horticultural Science, presented at the Philadelphia meeting of the society, December 30, 1940.

Council in its consideration of the obligation of the scientists of America to society in general and the defense program in particular.

It is timely also because the method and approach used by many, or should I say most, scholars in studying and attempting to solve the problems of human relationships, including economics, sociology and ethics, are at the present time apparently confused and ineffective. There has not been adequate leadership in these fields at a time when such leadership has been far more important than technological advance and control. Economic bungling of both governmental and private institutions and in industry during the past years of depression has brought out only too clearly the inadequacy of our society to handle the really important problems. It is indicated particularly by the failure among economists to have any answer upon which they can agree and no widely accepted method of approach to economic problems.

Modern ethics also is in a confused state. This was brought out most forcibly in a recent course of lectures on "Ethics and Modern Life," given at Cornell by a leader in that field. The titles of some of the lectures will indicate the confusion of thoughts and ideas that apparently exist. The first title was "The Dilemma of Modern Ethics." The dilemma seemed to be that there is no way by which the problem of human conduct could even be considered. Ideas just don't have any contact with action, and every term that is used is a dilemma in itself. The second lecture was on "The Venture of Moral Philosophy." The venture appeared to be that it was most extraordinary that any one would have the temerity to even try to do anything about conduct. The third lecture had to do with the divergence of theory and practice in which it was again brought out that it is practically impossible to bring ideas to bear upon the world of fact and experience. In the fourth lecture entitled, "The Modern Experiment; Ideas and Immediate Experience," it looked as if the lecturer were going to arrive at something which at least faintly resembled an effective approach to the problem, the scientific approach, if you please. The startling concept was advanced that possibly ideas could be brought to bear upon immediate experience. In the last lecture of the series, however, entitled "The Persistent Tension in Experience and Morals," the idea was given up and it was indicated that the whole matter was in a condition of confusion, futility and conflict. It gave no real hope to the human race for ever doing anything effective in directly meeting their problems in the improvement of social and moral relationships which is so necessary if civilization is to continue. Yet this authority in the field of ethics received nearly \$6.00 a minute for bringing his audience to such a state of

confusion and impression of futility. The above picture is, of course, overdrawn and can not be used as a basis for generalization. It does, however, contrast rather sharply with the situation where the scientific method is used as a tool in the solution of problems.

It is my belief that the method of science or the scientific approach is useful and effective in interpreting phenomena in all fields of human knowledge and endeavor and will aid in the solution of all problems with which the human race is confronted. It is also my belief that we as scientists have the opportunity, if not even the obligation, of bringing to bear upon the problems of living, both private and public, the method and approach of science. I submit that this method has had an outstanding record of accomplishment in the fields where it has been used and that the extension of its use as a working hypothesis for the solution of all problems is more practical and effective than any approach so far devised.

Before going further it is essential to make clear just what is meant by the scientific method. Here I know that much that is said will seem trite and well known to most or all of you. It is, however, necessary that such a statement be made, otherwise we do not know just what we are talking about.

Behind the scientific method are a number of basic assumptions which are taken as axiomatic. The first of these is that everything that takes place in the universe as we know it takes place in accordance with natural law. The second is that the human mind is capable of comprehending and understanding this natural law and hence can understand the universe. If this were not true the scientist could not work. What would be the use of spending our time investigating something that we can not understand. Of course, there is much in the universe of which we are not aware, much that our senses do not perceive, but we must assume that all could be perceived and understood if we were given, or if we devised, the proper instruments to perceive. The proof of such assumptions is that they work.

The radio is an obvious case in point. The natural law underlying the development of the radio has always been there. Radio waves, as such, are quite beyond the perception of any of our natural senses. However, by understanding the nature of these waves and how to control them it is possible to translate electric impulses into sound that we can perceive and enjoy. The air at this moment is full of all sorts of programs which, I am thankful to say at the moment, we do not perceive. By bringing in a radio properly tuned we are able immediately to make this apparent silence more audible.

As a further illustration of just what is meant by natural law I might cite the periodic table of atomic

weights as formulated by Mendeleyev in 1869. At that time only 70 elements were known, but on the basis of his hypothesis he postulated that there were 92 and went so far as to describe the properties of some of these that were still unknown. Within a comparatively few years 15 additional ones had been found, and now I believe all have been accounted for. When it was published in the newspaper that element 87 had been discovered it was no surprise. The chemists had known all along that it was there. Another example of what we mean by natural law is the comparatively recent discovery of the planet, Pluto. Astronomers knew by the behavior of other planets that such a planet existed and it only remained for a more powerful telescope to confirm its position. Who would doubt that the laws of astronomy have existed from the first? And so it is with other natural law.

Why many fail to appreciate the implications of the scientific method is that they do not consider natural law of universal application and are inclined to limit its scope to the physical sciences or to those in which material can be accurately weighed or measured. It is here that the greatest progress has been made and it is here that the factors with which the scientist deals are capable of the best controlled manipulation. Lord Kelvin has stated and I quote, "When you can measure what you are speaking about and express it in numbers, you know something about it, but when you can not measure it, when you can not express it in numbers your knowledge is of a meager and unsatisfactory kind: it may be the beginning of knowledge but you have scarcely in your thoughts advanced to the stage of science." This is a very significant statement, and in so far as the material concerned is capable of being measured and expressed in numbers it should apply. But certainly there is no particular virtue in numbers as such, and if the number does not honestly represent what it is supposed to represent it can be more misleading than a statement in words because the number gives an impression of accuracy that does not exist. It is my belief that some economists and biometricians have only confused our knowledge by using and manipulating numbers. Further, what is to be done with that great mass of phenomena which can not be measured and reduced to numbers but which is far more significant and important to human living than anything in the field of the physical sciences?

It might be possible to arbitrarily limit science by definition to those fields in which the material dealt with can be weighed, measured and expressed in numbers. This, however, is an untenable position because what we can measure to-day is far different from what we could measure yesterday and no one can venture what we may be able to measure to-morrow. To set

up such an arbitrary limit implies that somewhere in our universe there is a limit beyond which the scientific method does not apply. But there certainly is nothing in the basic assumptions of the scientific approach that would justify setting such limits. These assumptions are simple, namely, that the universe operates according to natural law and we as human beings can understand natural law and hence the universe. To say that this does not have universal application is to say that part of our universe is chaos and without causal relationship between events which take place and the forces and conditions that have brought them about. Personally I know of no scientist or scholar that would admit that such chaos exists anywhere and I insist that it does not.

Because of this concept that nothing is really science unless it deals with things that can be measured and given numerical values there has grown up a sort of hierarchy or aristocracy among the sciences in which the physicists and the chemists hold themselves somewhat aloof from the biologist, the psychologist, the economist and the sociologist, apparently feeling that after all physics and chemistry are the only true sciences and that the others are only pseudo-science. The biologist and the psychologist because they can effectively employ the experimental method in turn are inclined to look down their noses at the social sciences as being on an even lower grade of pseudo-science. This situation has been admirably described by Professor Boynton, of Chicago University, in his chapter on "Knowledge and Wisdom" in a recent book.

Apparently much of the difficulty is based on the assumption that nothing is truly scientific unless it can be adapted to experimental treatment in the laboratory. It is true that the experimental method has been identified with science itself from the first and rightly so, and that it is through experimentation that the outstanding advances of the past few decades have been made possible. It is also true that in the fields of knowledge which deal with human relationships and esthetics, experiments of the accepted laboratory type are difficult. This does not mean, however, that the basic principles of the scientific approach do not apply.

To emphasize this universality of natural law, it is useful to consider it as operating in different fields or at different levels. With no attempt at a complete classification we might set up a system something like this. First of all, there would be the physical level which would include physics and chemistry. The fact that chemistry in its last analysis is atomic physics is not important for developing the concept. Next would be the biological level. Here we are dealing with living things, the nature of protoplasm, the

physiology of plants and animals and such matters as health and medicine. Here would be considered all parts of man's nature that had to do with his biology. Psychology has to do with the workings of the mind and might be regarded as a phase of biology or at least to have an intimately associated biological basis. The process of thought is more complex and of a somewhat different nature than the physiological processes of digestion or respiration and for that reason psychology may well be set off from biology as such.

The social level has to do with relations between persons both as individuals and in groups and includes economics, sociology and ethics. We might also speak of an esthetic level or field which has to do with the appreciation of art and literature and poetry. Ethics and esthetics merge directly into what might be termed a spiritual level. In dealing with these upper levels the concept of value comes in. Thus, we speak of economic values, moral values, spiritual values. No attempt is made to give an exact relationship of these. The point to be made is that as we progress from one level to another there is continuity. If we accept evolution as a fact this could not be otherwise.

Also as we progress from one level to another, or from one set of values to another the nature of the natural law that is operating becomes increasingly more complex. It is, however, none-the-less real because it becomes less tangible and more difficult to handle experimentally. To further illustrate the point I am trying to develop it is well to consider some of these levels in more detail. The operation of physical law is obvious and accepted. No scientist has any doubt of its validity and the same is true of natural law in the biological field. This is the level with which the members of this Horticultural Society are primarily concerned. We recognize the application of chemistry and physics to our problems. But here in the biological field a new element that is very important comes in. We are dealing with living matter or protoplasm and its behavior not only as a substance, but as it is integrated in more complex organisms. The distinctive thing about protoplasm, however, is not the presence of certain chemical elements, but rather the integration of these. Of course, the elements which enter into the composition of protoplasm are essential, but merely to mix these in any given proportion is not to have protoplasm. The important thing about this substance is its organization, a thing which we destroy as soon as we try to treat it with chemical or physical techniques. It may be that eventually protoplasm will be partially explained in terms of stereo-chemistry and in last analysis atomic physics will contribute greatly to our understanding of its behavior. This, however, does not invalidate the concept. The important thing with

which the biologist deals is protoplasm as such and its behavior as a living integrated functioning entity that is more than the sum of the chemical elements of which it consists.

The question of absorption of water by roots and its movement into the xylem vessels was not explained satisfactorily as long as such movement was regarded as an osmotic phenomenon carried on by purely passive physical forces. It can be explained, however, on the basis of the action of the protoplasm as a living substance which moves salts against a diffusion gradient and secretes them into the vessel in such concentration that water can then move by osmosis. In the process energy is used and work is done and this depends upon the organization and functioning of the protoplasm itself. To be sure physical laws are concerned and none has been violated, though just how they work may not be too clear. The significant fact with which we are dealing, however, is the whole organization of protoplasm and cells and tissues which makes this phenomenon possible.

In the field of horticulture the use of chemical methods has been valuable in some problems. Too often, however, the chemist, particularly if he is not a horticulturist as well, has not contributed to the solution of problems as much as hoped for because of his failure to appreciate the plant as something other than a mass of chemical elements and compounds. As horticulturists we must never lose sight of the plant as a living functioning organism that is more than the sum of the chemical elements of which it is composed. This idea was well expressed by Dr. E. W. Sinnott in his presidential address before the Botanical Society in 1938. It certainly is one that we as horticulturists should not ignore.

In biological problems, particularly in studying the physiology of plants and animals we continually use the scientific approach at least in our basic concepts and attitudes. We assume that what we observe is going on according to natural law and that we can understand it. We are so sure of this that when apparent exceptions occur we merely conclude that our conception of the natural law that is operating is wrong and that we must search further to find out what is basically involved. This approach which we all use has been adopted because of the fact that in general it works, or at least works much better than any other approach which has been devised.

An example of the use of this approach might make our meaning more clear. Some weeks ago in the greenhouse at Cornell a chrysanthemum plant normally with dark bronze flowers was observed in which a part of the flower heads were light yellow, a part dark bronze and in some heads the florets were dark in the lower part of the head and light in the upper.

The question arose immediately as to the cause of this difference in color. Because of the position of the flowers, it was evident that bud mutation was not the answer. The difference in color was apparently related to the proximity to a steam pipe. Such an observation immediately suggested the possible effect of heat upon the color of the flowers in question. This, of course, is tied up with the nature of the coloring matter concerned. Knowing that the color was anthocyanin and that this is a derivative of sugar, immediately the problem becomes related to the sugar supply available for the production of this coloring matter. Increase in temperature is, of course, related to respiration so that the possible explanation might be that the color pigment was absent from the flowers next to the steam pipe because of the loss of sugar through increased respiration. Another relationship indicated in the heads with dark florets below and the light above was the effect of the progressive shortening of day length in relation to carbohydrate manufacture. Heads that had color in the basal florets might have developed relatively earlier during longer days than those in the center. Under such conditions the sugar supply available at the time the florets were forming might be the controlling factor in determining the color. Doubtless other factors were also operating, and in any case these hypotheses would have to be proved experimentally before acceptance.

This example merely illustrates the scientific approach to a problem. First, we ask the question, "What is it that has happened and what are the materials involved?" Next, "What are the factors operating that might bring about the changes which we have observed?" Then, "What are the natural laws which are operating in controlling these factors?" It is my contention that this method of approach is valuable in approaching any problem.

At the psychological level we are dealing with something a little different from that found at the lower levels. Here again there is increased complexity. Nevertheless there is continuity in the natural law operating in the psychological field throughout the animal kingdom. There is no break between man and the other animals. The psychologists, of course, or at least many of them, have recognized this and have adopted the scientific method. Certainly there would be no logic in working with rats, dogs or pigs if this continuity did not exist. The natural law underlying psychological behavior seems to be relatively well understood compared to such understanding in the fields of economics and ethics. At least it is being made of practical use on a wide scale. We have only to mention such terms as "child training," "high pressure salesmanship," "propaganda" and the like to show this to be a fact. The astounding effec-

tiveness of the Hitler régime is based largely on the control of some psychological factors. We can only hope that his knowledge is inadequate to carry out his plans in their entirety. Certainly neither the effect of bombing upon the British morale nor the imprisonment of the German clergy in concentration camps has worked out as was planned and indicates a lack of understanding of the psychology of these people.

Here again in the psychological field we are dealing with natural law that is unlike physical law and unlike most of the natural law in the biological field also. We are concerned with human response. Attempts are made to reduce human behavior to terms of endocrine secretions, blood pressure and similar factors. To get any significance out of human relationships, however, it is futile to reduce human behavior to such terms. The minute we try to break down a human reaction in terms of solutions and secretions the thing itself is lost. It is like trying to find out the nature of protoplasm by subjecting it to chemical analysis. As soon as it is manipulated with chemical techniques the significant thing about it no longer exists. For example, take the behavior of an affectionate child toward its father. On meeting after a separation, at the first sight of the parent the child comes running to him with every expression of eagerness and joy. Such actions are doubtless associated with various physical and chemical stimulations and electrical phenomena of one kind or another. However, these are not the significant things about it. The significant fact with which we are dealing is the whole complex phenomenon in its entirety.

In the field of economics the situation becomes even more involved and complex because we are considering not the psychology of an individual but the behavior of groups of individuals with regard to other groups and are also concerned with their relationship to various materials and commodities. Yet there is no question but in this field there are laws which operate in spite of Federal Farm Board legislation and the Agricultural Adjustment Administration or any other governmental organization. It seems to me evident that much of the difficulty of the past years during the depression is due to the fact that many economists do not use the scientific approach to their problems. Although some of them do use this approach there is such disagreement as to valid methods that great confusion has resulted. It is also entirely possible if not altogether probable that some of the so-called natural laws which have been thought to operate in the economic field are not valid. This does not mean, however, that such law is wanting and that it may not be discovered if studied in an effective manner.

In our personal relations with others natural law is

operating, also. The so-called laws of friendship have a very real meaning. It must be perfectly obvious to all of you that certain reactions in other people will follow certain courses of action on your part. It is quite possible to make another angry or to arouse many other positive or negative reactions at will.

The field of ethics has to do with personal conduct as related to what is right or wrong. Here, conduct must be judged in the light of the society in which it occurs. A thing is good or bad, moral or immoral, only when related to some specific situation or environment. Still there is no chaos, though some would say that there was. I recall hearing a famous criminal lawyer discussing this matter before a gathering of college students at Wesleyan University, Connecticut. The whole effect of his talk was to leave the students with the idea that there was no basis for judging conduct as moral or immoral, good or bad, and the general concept was that society had no right or justification in punishing criminals for what they do because it had no valid standards of what is right or wrong. It would seem to me that this conception was contrary to fact at least in so far as holding that there was no way to determine what was right or wrong. In this day and age and in our society a person of good moral character is a perfectly definite sort of person. We know what to expect in the way of behavior from such an individual. Each one of us has friends about whom we would not believe a report of their having done an immoral or disgraceful act. On the other hand, we may also have acquaintances about which such reports would be accepted as the thing to be expected. A possible concept of ethics might be stated after this fashion—Behavior is right or ethical if it is in accordance with natural law operating in a constructive manner. This has to do only with human behavior, as there is no ethics in the field of physics and chemistry.

In considering any behavior the level of the natural law that is operating must be considered. A thing may be right at one level and wrong at another. Certain behavior for example may be quite moral on the biological level with no immoral social implications whatever in a society like that of the early Polynesians, whereas the same course of action might be highly immoral in our own society judged on the basis of its biological, economic or social significance.

It is not my purpose to discuss ethics further than to point out the fact that natural law is operating in this field also. It is my firm belief that there is a fundamental and universal law governing human conduct under which human beings can achieve the best possible and most satisfying relationships. This has to do with many things that are known and recognized.

The qualities of honesty, loyalty, truth, decency, kindness, unselfishness and the like are constructive in their effect upon individual and social life and in the long run will make for a better society than their destructive counterparts. It is obvious that if individuals and nations conducted themselves along these constructive lines the chaos which now confronts the civilized world would not exist. The point is emphasized here that any problem of ethics can be approached effectively by using essentially what we understand as the scientific method. It is granted without argument that our knowledge of natural law is incomplete, particularly at the economic, social, ethical and spiritual levels and that the technique of the chemistry laboratory can not be carried over directly into the field of sociology and ethics. Not so long ago, however, chemical and physical laws were also unknown. Certainly no scientist can take the position that anything will be impossible in the future in the way of understanding and in controlling our universe. Further and more important, I would maintain that the scientific method is the most effective approach we have in dealing with our problems of whatever sort and can be taken as a working hypothesis upon which we can base our activities. At least, until we find a better one it will go far in giving meaning to our universe in fields where otherwise chaos and confusion exist.

I hope that I am not being misunderstood. It is the farthest from my desire to advocate that the members of this society become less zealous in doing effective work in the science of horticultural research. Rather, it is to point out that we as scientists should realize more fully that in the scientific method we have an extraordinarily effective technique that can be brought to bear upon the problems outside the field of the physical and biological sciences. Further it is our opportunity and obligation to take some responsibility for the social and political order in which we work and which makes our work possible at all. With such a broad concept of responsibility the scientist would not abandon the scientific method when he closes the door of his laboratory each day, but would carry the same critical and dynamic approach with him wherever he goes.

In these troublous times when four fifths of the nation paused to hear President Roosevelt's statement of the crisis with which we are confronted, we as scientists are in a favored position to be of outstanding service. We, more than any other group, have the approach that will be most effective in meeting the problems raised by events as they come, provided, of course, that we realize at least some of the social implications of the scientific method.

## OBITUARY

## ROBERT THOMAS HILL

1858-1941

ON July 28, in Dallas, Texas, Dr. Robert Thomas Hill, well-known geologist and the author of many papers, died at the age of eighty-two years. He was born in Nashville, Tennessee, and at the age of five was orphaned by the Civil War. When fifteen years old, he moved to Comanche, Texas, which at that time was "the last town of the frontier and the roughest and toughest of that age." Here he helped set type on his brother's weekly, the *Comanche Chief*; punched cattle; and had a variety of hard experiences which, in later years, gave him subjects for many an exciting tale.

As has so often happened, so, too, in Robert Hill's case, discovery of a fossil shell awakened his first interest in geology. This was while he was still in Tennessee. He broke the corner off a block of rock and thus exposed a shell impression which started his career. However, not until he was in his twenties did he finally take the advice of a barber friend who urged him to write to the *New York Sun* for information as to where a young man might get an education. He was told to write to President Arthur D. White of Cornell and, having received an encouraging reply, he went east and began the four years of educational training which led to a bachelor of science degree in 1886. These years were not easy, for he had to earn his living and his tuition by various odd jobs, but he always remembered them as among the happiest years of his life.

Following graduation, Hill was appointed assistant paleontologist on the U. S. Geological Survey. In 1888 he became assistant geologist, and in 1889 he was promoted to the grade of geologist, a position which he held until 1904. In 1898 he was also geologist on the Arkansas State Geological Survey. From 1889 to 1891 he was professor of geology at the University of Texas. In 1895 he cooperated with Professor Alexander Agassiz in West Indian exploration. His studies carried him, also, into New Mexico, Mexico and the Isthmian region. Thus, it happened that he acquired wide experience in the geology of the lands fringing the Gulf of Mexico and in the Antillean region.

Evidence of this concentration in his work appears in his numerous contributions to geologic literature, of which there are at least 150. Of these a large number relate to Texas, but not an inconsiderable number refer to Arkansas, New Mexico, Oklahoma, Mexico, California, Cuba, Puerto Rico, Jamaica, Costa Rica and Panama. Although, in his writings, he stressed geology, stratigraphy and geography, some described

prospects for clay, oil, ores, coal and marble. Greatest of his economic contributions, however, were his reports on artesian water resources in Texas.

Two comprehensive treatises cover Hill's work on this subject of underground waters. The first, written with T. W. Vaughan as co-author, was entitled "Geology of the Edwards Plateau and Rio Grande Plain adjacent to Austin and San Antonio, Texas, with reference to the occurrence of underground waters," and was published in the 18th Annual Report of the U. S. Geological Survey, in 1898. The second, "Geography and Geology of the Black and Grand Prairies, Texas," appeared as the 21st Annual Report of the U. S. Geological Survey in 1900. In these two monumental reports are the data and recommendations which, throughout a broad belt in Texas, have guided farm and industrial life in the exploitation of valuable water resources. The usefulness of these two volumes has been inestimable.

In the later years of his life, Dr. Hill wrote little on geology, but he began a series of articles, which he continued for several years in the *Dallas News*, on the wanderings and expeditions of the early whites in Texas and adjoining states. Due to his intimate knowledge of the geography and geology of the region, he was able to trace the routes followed by the old Spaniards and others who laid the course of this chapter in American history.

Dr. Hill belonged to many scientific societies. He was a founder member of each of the following: the Geological Society of America, the Washington Academy of Science, the American Society of Professional Geographers, the Southwestern Geological Society, the Branner Geological Society of Los Angeles, the Society of Economic Geologists, the Texas Historical Society, the Engineers Club of New York, the Explorers' Club, and others.

Dr. Hill was small of stature and in the later years of his life he was blind in one eye and was so deaf that conversation with him was difficult. Yet he kept in remarkably close touch with everything going on in the field of geology; his reduced vision was still keen, for he seldom failed to recognize his friends even at a distance, and he could enjoy examining rock outcrops and rock specimens. To the last his mind was as clear as crystal and his memory was extraordinary. He was a man of wide interests, strong for what he believed was right and fair, but relentlessly opposed to graft and bigotry and other forms of human corruption. He was especially outspoken against political and economic issues which he thought were adverse to the common good. In his passing he has left a host of friends and admirers, not only the hundreds of

geologists and other technical men who knew him, but also thousands of persons in many other walks of life.

FREDERIC H. LAHEE

### RECENT DEATHS

DR. DANIEL DANA JACKSON, since 1918 professor and head of the department of chemical engineering at Columbia University, died on September 1 at the age of seventy-one years.

FRANK LEWIS EIDMANN, since 1930 professor of mechanical engineering at Columbia University, died

suddenly on September 4 of a heart attack in his laboratory. He was fifty-three years old.

BRIGADIER-GENERAL CHARLES HAMILTON MITCHELL, hydraulic engineer, who recently retired as dean of the faculty of applied science and engineering at the University of Toronto, died on August 26. He was sixty-nine years old.

CLAUDE MACKENZIE HUTCHINSON, bacteriologist, formerly chief scientific adviser in India to the Imperial Chemical Industries, died on August 2 at the age of seventy-two years.

## SCIENTIFIC EVENTS

### INTERNATIONAL RELATIONS OF SCIENCE

THE Division for the Social and International Relations of Science of the British Association for the Advancement of Science is arranging a meeting to be held, if circumstances allow, on September 26, 27 and 28. Various subjects under the general heading of "Science and World Order" will be taken up. The first day's session will be held at the Royal Institution, London, and those of the second and third days at the Rothamsted Experimental Station, Harpenden.

Since the above note, received from English sources, has been in type a Renter dispatch dated September 7 has been printed in *The New York Times*, which reads: Representatives of Great Britain, the Empire, the United States, Soviet Russia and China will meet in London for a scientific conference from September 26 to 28, "to demonstrate the common purpose of men of science in insuring a post-war order in which the maximum benefits of science will be secured for all people." United States Ambassador John G. Winant, Soviet Ambassador Ivan M. Maisky and Dr. V. K. Wellington Koo, Chinese Ambassador, will preside at some of the sessions. Czecho-Slovakia, Poland, Norway, the Netherlands, Belgium and France will be represented, and scientific workers from Germany and Austria will probably also be present.

In reply to the cable of greetings sent by the Royal Society, London, to the Academy of Sciences of the U.S.S.R., quoted in *SCIENCE* for August 29, Dr. Otto Schmidt, vice-president of the academy, according to English journals, has sent the following message: "The Academy of Sciences of the U.S.S.R. sends its warmest greetings to the Royal Society, London. Soviet scientists express feelings of deep admiration and friendship to British colleagues who in war conditions pursue courageously their research work, obtaining world achievements in various fields of science and thus successfully opposing the aim of Fascism to destroy all culture. In the struggle for the happy future of humanity, standing hand in hand against the

common foe, men of science of Great Britain and the Soviet Union will contribute with all their forces to the triumph of liberty, culture and science over Hitlerite tyranny and obscurantism."

### THE OFFICE OF DEFENSE HEALTH AND WELFARE SERVICES

AN Office of Defense Health and Welfare Services in the Office for Emergency Management has been established in Washington by President Roosevelt, who has issued a proclamation detailing the functions of the agency. Paul V. McNutt, head of the Office for Coordination of Health, Welfare and Related Services in the Council of National Defense, has been named director.

The functions of the new agency were outlined in the proclamation as follows:

Subject to such policies, regulations and directions as the President may from time to time prescribe, the office shall:

A. Serve as the center for the coordination of health and welfare services made available by the departments and agencies of the Federal Government, and other agencies, public and private, to meet the needs of state and local communities arising from the defense program and take necessary steps to secure the cooperation of the appropriate Federal departments and agencies relative thereto.

B. Make available to states and localities, upon request, the services of specialists in health and welfare activities to assist in the planning and execution of such local and state programs.

C. Study, plan and encourage measures designed to assure the provision of adequate defense health and welfare services to the citizens of the nation during the period of emergency and coordinate studies and surveys made by Federal departments and agencies with respect to these fields.

D. Keep the President informed with respect to progress made in carrying out this order and perform such related duties as the President may from time to time assign or delegate to it.

### THE WESTINGHOUSE TIME CAPSULE

THE Park Department of New York City announces that a monument of black granite, erected at Flushing Meadow Park to mark the location of the Westinghouse Time Capsule on the old site of the New York World's Fair, will be dedicated at noon on Tuesday, September 23.

At the public ceremonies sponsored by the Park Department, Robert Moses, Park Commissioner, will preside. David S. Youngholm, vice-president of the Westinghouse Electric and Manufacturing Company, will present the marker, and Mayor F. H. LaGuardia, or his representative, will accept the memorial on behalf of the City of New York. Executives of the principal companies which had exhibits at the fair, members of the fair administration, city officials and civic leaders will attend. The Time Capsule, a metal tube containing a record of our civilization, was buried fifty feet underground at the Westinghouse Building at the World's Fair to remain there for 5,000 years.

It contains thirty-five articles of common use and a microfilm record equivalent to 10,000,000 words of printed matter and was sealed on September 23, 1940, with leaders of American science, industry and public affairs taking part. It is made of copper alloy called Cupaloy which can be tempered to the hardness of steel and yet has a resistance to corrosion equal to pure copper. The torpedo-shaped shell is lined with an envelope of heat-resistant glass set in waterproof wax.

To preserve the memory of the Time Capsule and perhaps aid future archeologists in finding it, a permanent "Book of Record" was distributed to libraries, museums, monasteries and other repositories throughout the world.

The ten-foot black granite monument standing on a white granite base marks the exact spot where the capsule is buried at latitude  $40^{\circ} 44' 34''.089$ , north of the equator, longitude  $73^{\circ} 50' 43''.842$  west of Greenwich. An inscription on the base of the shaft reads:

The Time Capsule, deposited 50 feet beneath this spot on September 23, 1938; preserving for the future a record of the history, faiths, arts, sciences and customs of the people then alive. Scientists and engineers designed it; scholars chose its contents; the Westinghouse Electric and Manufacturing Company placed it here at the beginning of the New York World's Fair, 1939-1940, to endure for 5,000 years.

As part of the development of Flushing Meadow Park, the Park Department approved the construction and erection by Westinghouse of a memorial to mark the Time Capsule site. Five white granite seats, with black granite arm rests, face the shaft in a semi-circle from the south end of the memorial plot, which is 45

by 30 feet in area. The area is paved with dolomite flagstones from the court of the former Swedish Pavilion at the Fair. A replica of the capsule is on display at the Hayden Planetarium of the American Museum of Natural History in New York City, where duplicates of the original contents also are shown.

### CELEBRATION AT RUTGERS UNIVERSITY

CONFERENCES in connection with the one hundred and seventy-fifth anniversary celebration of Rutgers University will be held on October 9 and 10. These conferences, which will comprise lectures and symposia in four fields of learning, have been arranged to provide an opportunity for scholars to discuss and correlate present knowledge, and to consider subjects for future research. On October 9 the program of lectures and symposia, in separate sections, will be devoted to social science and to applied science; on October 10, to the natural sciences and to literature and the fine arts.

Dr. Karl T. Compton, president of the Massachusetts Institute of Technology, will give the anniversary lecture before the Section on Applied Science. It will be entitled "Scientists Face the World of 1942." Speakers at a symposium before the section will be Dr. Vannevar Bush, president of the Carnegie Institution of Washington, who will speak on "The Case for Biological Engineering," and Robert V. Trullinger, of the U. S. Department of Agriculture, who will speak on "The Case for Agricultural Engineering."

Dr. Hugh Stott Taylor, of Princeton University, will give a lecture before the Natural Science Section on "Fundamental Science from Plogiston to Cyclotron." "Films in Chemistry and Biology" is the subject of a paper by Dr. Irving Langmuir, of the General Electric Company, and "Nuclear Physics and Biology," of a paper by Professor Ernest O. Lawrence, of the University of California.

The anniversary convocation on October 11 will be addressed by Dr. Clarence A. Dykstra, president of the University of Wisconsin, after which honorary degrees will be awarded.

### AWARD OF THE BALY MEDAL OF THE ROYAL COLLEGE OF PHYSICIANS

*Nature* writes: "Professor Edgar Allen, to whom the Baly Medal of the Royal College of Physicians has been awarded, is professor of anatomy in the Yale University School of Medicine, a post to which he succeeded in 1933 after a very fruitful period of office in the University of Missouri. In both universities his department has proved a vigorous center of research on the sex hormones, and his own contributions to the subject form an essential foundation to

modern knowledge of the endocrine action of the ovaries. Before 1917 attempts to isolate ovarian internal secretions were seriously handicapped by the lack of a specific test for what to-day is called oestrogenic action. In that year Stockard and Papanicolaou showed that the oestrous cycle in the guinea pig is associated with cyclical changes in the vaginal epithelium. Shortly afterwards Allen found that in the mouse, too, oestrus is associated with a specific vaginal phase, and from this discovery it was a short step to his and Doisy's successful application of the vaginal smear technique as a test for the oestrogenic action of ovarian extracts. Once extracts with demonstrable oestrogenic activity were made available, the door was open to the chemical isolation, analysis and synthesis of pure oestrogens. Although Allen did not share in this later chemical work, there can be little question that it would have proved impossible without the simple bio-assay method which he developed.

"Allen's second major achievement was his demonstration in 1926 of the fact that the follicular phase of the uterine cycle in monkeys and man is under the control of oestrogenic hormone. All later work on the primate cycle emerges from this finding, and Allen's own subsequent investigations have a significant place in the structure of present knowledge of the subject. His contribution does not rest here. Allen is that rare combination of research worker and administrator who is able to stimulate in younger men a strong and lasting interest in research. His laboratory is one of the most productive in the United States, and while the Baly Medal is a recognition of past work, endocrinologists the world over know that Allen's laboratory will prove no less successful in the future than it has in the past."

#### AWARDS OF THE AMERICAN CHEMICAL SOCIETY

THE Priestley Medal of the American Chemical Society was presented on September 8 to Dr. Thomas Midgley, Jr., vice-president of Ethyl Gasoline Corporation, at the opening session of the one hundred and second meeting. Dr. Midgley, discoverer of tetra-ethyl lead as an anti-knock agent in gasoline, was honored for outstanding achievement in chemical science.

The \$1,000 prize in pure chemistry, awarded annually to a chemist under thirty-six years of age, and sponsored this year by Alpha Chi Sigma, the national scientific fraternity, was presented to Dr. Karl A. Folkers, of the Merck and Company, Inc., for important contributions in the field of organic chemistry.

Dr. Folkers has isolated many rare alkaloids from tropical plants and has conducted intensive research in the fields of vitamins and pyrimidines.

Professor William Lloyd Evans, of the Ohio State University, president of the society, made the presentations. In an address accepting the Priestley Medal, which is awarded once every three years, Dr. Midgley, who is chairman of the board of directors of the society, gave a demonstration of spectacular industrial developments arising from research with which he has been associated during the past twenty years.

By means of an actual gasoline engine, chemical apparatus, motion pictures and slides, Dr. Midgley demonstrated the effect of anti-knock material in a running engine; the non-toxic, non-inflammable properties of certain organic fluorides largely responsible for a great portion of the air-conditioning industry; the experiments through which he and his associates discovered that rubber containing oxygen could be vulcanized by the addition of Grignard reagents, and the process of commercially extracting bromine from sea water.

His discovery in 1922 of tetra-ethyl lead as an anti-knock agent was made after he and his colleagues in the General Motors Research Laboratories had tried more than 33,000 different chemical compounds without success. Dr. Midgley was born in Beaver Falls, Pa., in 1889 and is a graduate of Cornell University. He holds the Nichols Medal of the New York Section of the society, and the Perkin Medal of the Society of Chemical Industry. The honorary degree of doctor of science was conferred upon him by Wooster College. He is a fellow of the American Association for the Advancement of Science. In September, 1940, Dr. Midgley was stricken with infantile paralysis. Despite his disability, however, he is actively participating in the convention proceedings.

Dr. Folkers was born in Decatur, Ill., in 1906. He received the degree of bachelor of science with honors from the University of Illinois in 1928, and the degree of doctor of philosophy in 1931 from the University of Wisconsin. He was a teaching assistant in 1928 and a research assistant and fellow in 1929-31 at the University of Wisconsin, and a post-doctorate research fellow in organic chemistry from 1931 to 1934 at the Sterling Chemistry Laboratory of Yale University. He is the author and co-author of many publications in the field of organic chemistry. He joined Merck and Company in 1934, and four years later was appointed assistant director of research. Dr. Folkers was co-recipient in 1940 of the Mead Johnson and Company Award for research on the vitamin B complex.

## SCIENTIFIC NOTES AND NEWS

DR. LOUIS F. FIESER, Sheldon Emery professor of organic chemistry at Harvard University, has been awarded the Katherine Berkan Judd \$1,000 prize of the Memorial Hospital for the Treatment of Cancer and Allied Diseases, New York City, in recognition of "his outstanding contribution in the proof of the active and inactive positions in the molecules of the chemical carcinogens."

HENRY L. WARD, who retired in May as director of the Neville Public Museum, Green Bay, Wis., has been awarded a gold medal by the Illinois Academy of Science for distinguished services to midwest archeological science. He has been succeeded at the museum by Earl G. Wright, of the Chicago Academy of Sciences.

It is stated in *Nature* that at the recent conferring of degrees at the Queen's University, Belfast, the degree of doctor of science was conferred on Bryan A. Toms, of the department of chemistry of the university.

THE National University of Tucuman, Argentina, elected on July 15 the following honorary collaborating members of the Institute of Anthropology: D. Alfredo Metraux, Yale University; Dr. E. W. Count, New York Medical College; Dr. J. M. B. Farfan, University of San Marcos, Lima; Dr. Maria M. Constanzo, University of Buenos Aires; Dr. Clemente Hernando Raimori, University of Tucuman, and Dr. Guillermo Rohmeder, University of Tucuman.

DR. CALVIN P. STONE, of Stanford University, was elected president of the American Psychological Association at the recent Chicago meeting. Other officers elected were: *Secretary*, Dr. Willard C. Olson, of the University of Michigan, and *Treasurer*, Dr. Willard L. Valentine, of Northwestern University.

ACCORDING to the *Journal* of the American Medical Association, Dr. Desiderio Roman, of Philadelphia, was named on August 16 *president-elect* of the International College of Surgeons at the international assembly in Mexico City, and Dr. Fred H. Albee, of New York, was inducted into the presidency. The *vice-presidents* are: Drs. Chevalier Jackson, Philadelphia; Manuel A. Manzanilla, Mexico City; Herman de Las Casas, Caracas, Venezuela; Alex Stanischew, Sofia, Bulgaria, and A. M. Dogliotti, Catania, Italy. Dr. Max Thorek, Chicago, is the *international executive secretary*. Dr. Thomas A. Shallow, Philadelphia, was chosen *president* of the U. S. chapter; Drs. Raymond W. McNealy, Chicago, and James R. Jaeger, *vice-presidents*; Benjamin I. Golden, Elkins, W. Va., *treasurer*; Charles H. Arnold, Lincoln, Nebr.,

*executive secretary*, and George H. Gillen, Denver, *secretary of the scientific assembly*.

DR. PARIS B. STOCKDALE, associate professor in the department of geology at the Ohio State University, has been appointed professor and head of the department of geology and geography at the University of Tennessee. Dr. George W. White, professor and head of the department of geology at the University of New Hampshire, will become professor of geology at the Ohio State University. Dr. J. O. Fuller, of Mt. Union College, Alliance, Ohio, has been appointed instructor in the department of geology at the Ohio State University. He succeeds Dr. George R. Gibson, who resigned last June to become associated with the Magnolia Oil Company.

DR. PAUL M. HARMON, of Indiana University, has been appointed chairman of the department of physiology in the School of Medicine, succeeding Dr. William J. Moenkhaus, who retired in June. Dr. Khalin G. Wakim, of the Mayo Clinic, has been appointed associate professor of physiology.

DR. ROBERT M. MELAMPY, until recently assistant apiculturist of the Southern States Bee Laboratory of the U. S. Department of Agriculture at Baton Rouge, has been appointed assistant professor of zoology at the Louisiana State University. Dr. Melampy's work will be primarily in the field of general and insect physiology.

DR. W. E. KAUFMANN has resigned as professor of chemistry and chairman of the department at Alma College, Michigan, to accept a similar appointment at Carleton College, Northfield, Minn.

DR. HENRI DE BAYLE, a graduate of the University of Pennsylvania, past president of the Pan American Medical Association and formerly Nicaraguan Minister to the United States, has been appointed dean of the new School of Medicine of the Central University of Nicaragua.

DR. JACK CECIL DRUMMOND, professor of biochemistry in the University of London and scientific adviser to the Ministry of Food, has been elected Fulmerian professor of physiology in the Royal Institution. He succeeds Sir Frederick W. Keeble.

HARRY C. OBERHOLSER, of the Fish and Wild Life Service of the Department of the Interior, formerly senior biologist of the Biological Survey of the U. S. Department of Agriculture, has retired. He planned to retire a year ago when he reached the age of seventy years, but his appointment was extended for a year to give him time to finish his work on the birds of Texas. He now has been appointed curator of the

department of ornithology of the Cleveland Museum of Natural History, to succeed John W. Aldrich, who left the museum last January.

It is reported in *Museum News* that Stanley C. Arthur has been elected executive director of the Louisiana State Museum, New Orleans, in succession to Andre S. Chenet, resigned. Mr. Arthur had been president of the board of curators of the museum until his resignation on June 18.

LEWIS W. WEBB, JR., associate professor of engineering in charge, was recently appointed director and executive officer for the Engineering Science and Management Defense Training Program at the Norfolk College of William and Mary-Virginia Polytechnic Institute. This defense program, now serving the needs of defense training in the Virginia Tidewater area, has approximately eight hundred night school students enrolled in science courses.

DR. ROLLA E. DYER, assistant director of the National Institute of Health, and Dr. Norman H. Topping are now in La Paz, Bolivia. They are working with Dr. Felix Vientemillas, director of the National Health Laboratory, in an attempt to determine by experiments on Indian miners in isolated villages the value of a new vaccine for typhus fever. The vaccine, which was discovered by Dr. Herald R. Cox, at the U. S. Public Health Service Laboratory, Hamilton, Mont., has been successfully used in experiments with animals.

DR. JACQUES HADAMARD, professor emeritus of mathematics of the Collège de France, commander of the Legion of Honor, who is now seventy-five years old, has arrived in the United States. He expects to join the Institute for Advanced Study at Princeton.

ACCORDING to press reports, Dr. Paul Langevin, formerly professor of physics at the Collège de France, is being held by the Gestapo under surveillance at Troyes. He was arrested in Paris in December and was released from prison a few weeks later.

IN the early part of August, Fr. Marie-Victorin, honorary president of the Société Canadienne d'Histoire Naturelle, with Fr. Rolland-Germain and M. Auray Blain, of the Jardin Botanique de Montréal, returned from a preliminary taxonomic and ecological survey of the newly opened route from Senne-terre to Mont Laurier, Quebec. This highway passes through virgin forest never before visited by botanists, and makes it accessible to study the flora of a northern Laurentian area whose general characteristics have hitherto been unknown.

DR. ERNEST O. LAWRENCE, professor of physics at the University of California, will deliver on September 25 a public lecture, illustrated with lantern slides

and experimental demonstrations, on "The Cyclotron in Medicine," under the sponsorship of the Institute of Medicine of Chicago in the auditorium of the Museum of Science and Industry.

DR. ALFRED H. STURTEVANT, professor of genetics at the California Institute of Technology, gave on August 27 the evening lecture at the summer meeting of the Genetics Society of America at Cold Spring Harbor. His subject was "Comparative Genetics of the Species of *Drosophila*."

A CLINICAL session on pulmonary diseases will be held at the Cornell University Medical College under the auspices of the Tuberculosis Sanatorium Conference of Metropolitan New York on October 8. The speakers will be Drs. Norman H. Plummer and Edgar Mayer.

THE opening of the Pennsylvania State College has been postponed for a week, until September 18, on account of the prevalence throughout the state of poliomyelitis.

THE will of William Mitchell Kendall, senior member of the architectural firm of McKim, Mead and White, who died on June 29 at the age of eighty-five years, leaves his estate at Sutton, Me., with \$25,000 for its maintenance, to Harvard College as a "place for rest, recreation and study" for members of the faculty and their families.

YALE UNIVERSITY will receive \$180,000 by a provision in the will of Mrs. Mary Jewett Wilson, widow of Edward A. Wilson, mining engineer, to found and maintain scholarships to be named after her husband. The amount remaining after scholarships are paid will be contributed to the class of 1871 university fund.

THE *Journal* of the American Medical Association states that the Helis Institute for Medical Research has been created by a trust fund made available by William G. Helis, of New Orleans, to provide funds for the conduct of medical research and the advancement of the medical sciences. The institute intends to establish various clinical and experimental divisions at medical schools and hospitals, the first of which has already been set up as the Center of Research of Hotel Dieu Hospital. All research carried on at these centers will be financed by the institute. Dr. Carlo J. Tripoli, assistant professor of medicine, Louisiana State University School of Medicine, New Orleans, has been appointed director of the institute.

FORDHAM UNIVERSITY will bring the celebration of its centennial year to a close on September 15, 16 and 17 with a program of lectures and round table discussions on topics of interest both to the general

public and to specialists. Distinguished American and Canadian scholars will offer the results of their cultural interests and pursuits in those fields to which the university has devoted its century of service: Classics, English, Romance Languages; History, Law, Sociology, Education, Economics; Philosophy, Psychology; Biology, Chemistry and Physics. On Tuesday evening there will be a dinner at the Waldorf Astoria. On Wednesday morning, following the academic procession, delegates appointed from colleges, universities and learned societies will be presented to the president, trustees and faculties of the university, and a number of honorary degrees will be conferred.

THE *Journal* of the American Medical Association reports that a grant of \$52,000 from the Rockefeller Foundation for a cooperative program of research in biology and medicine to be conducted by the Mayo Foundation, Rochester, Minn., and the University of Minnesota has been received by the board of regents of the university. The gift will be used in the study of radioactive isotopes as tracers of fundamental bio-

logic mechanisms. Under the direction of Dr. John T. Tate, members of the staff of the university and the Mayo Foundation have conducted this research since 1937, when a grant of \$36,000 was awarded by the foundation. The university has also received from the foundation a grant of \$17,000 to support research in the field of biophysics under the direction of Dr. Otto H. Schmitt, instructor in physics and biology.

ATLANTA UNIVERSITY, Georgia, will open this month a School of Library Science, made possible by a grant of \$150,000 for endowment by the Carnegie Corporation of New York. To the income from this grant the university is adding money from other sources. The school will be of the class designated as Type II, that is, one requiring graduation from an accredited four-year college for admission, and offering a one-year professional course for the training of librarians. The annual enrolment will be limited approximately to twenty-five students whose academic records and personal qualities seem to indicate that they will succeed as professional librarians.

## DISCUSSION

### REORGANIZATION AT THE LOS ANGELES MUSEUM

SCIENTISTS throughout the world look to two agencies for the preservation and continuance of scientific phenomena, the great libraries and the great museums. The museum has come to be not only a place of exhibition but a repository of valuable scientific specimens, especially of types and co-types, requiring curators who are specialized in the abilities to classify and to organize such materials as may come under their stewardship. Among the several museums of America, one of the most important in many respects, because of its unique position in the Pacific Southwest, is the Los Angeles County Museum of History, Science and Art.

This museum was brought into existence on February 7, 1910, by a contract entered into between the Los Angeles County Board of Supervisors and four local organizations, namely, The Historical Society of Southern California, The Fine Arts League, The Southern Division of The Cooper Ornithological Club and The Southern California Academy of Sciences. According to this agreement these organizations were given the right to choose seven of the nine members of a board of governors, which was to administer the affairs of the museum. In January, 1918, this contract was amended to allow a gift of the Brea Beds, now Hancock Park, to be added under the supervision of the Los Angeles Museum.

A short time ago *Museum News* gave a very condensed account of certain changes that were to occur

at the Los Angeles Museum. Because of its incompleteness, and because of the interest evidenced throughout the nation in this reorganization, it is regarded as timely to add a few remarks herein.

In 1938 the County Board of Supervisors, at the advice of counsel, declared the original contract invalid by appointing a new board of governors consisting of 15 members, none being chosen or suggested by the founding societies. Only one member on the present board remains as the chosen representative of a founding society. The same ordinance provided for the following directors: Finance and Operation, History and Anthropology, Science, Art, and Art Instruction. In 1939 a new ordinance established a director in charge and specified that the divisional directors should constitute themselves as an advisory council for the consideration of interdivisional matters and for other purposes concerning the best interests of the institution, reporting semi-monthly through the director in charge to the board of governors, its powers being recommendatory only.

In 1940 the ordinance establishing the administrative council was repealed, which made it possible to effect a complete and radical reorganization without consulting the directors of the several divisions. In April of this year the directors of history and science learned, through newspaper clippings, that such a change was scheduled to go into effect. The ordinance (as of May 22, 1941) which brings these changes provides for the abolition of the division of history, science and art and creates in lieu thereof the divisions

of exhibitions and education. The personnel of the former divisions are distributed to the two new divisions, with certain eliminations inevitable in the shake-up.

The staffs in history and science are drastically cut by a system of transfers. Demotions of the professional and technical personnel are made in all divisions, which includes directors, senior curators and curators, the latter reduced to curatorial assistants. Without cause, men and women of high scholastic standing and national reputation have been demoted. There have been no hearings, no impartial investigations.

It becomes apparent that a complete change is effected in the basic structure and functions of the museum which is at wide variance with the plan of the founders. In effect, it becomes a museum of exhibitions, art instruction and "education." The latter function serves principally as an instructing agency for the schools, and for circulating study materials. Both of these agencies have been carried on by the museum, under other names, since 1927, and supplements a similar activity of the Visual Education Section of the Los Angeles City School system. The directors of history and science have stated to the writer that in the past there has been no dearth of instructors to meet the needs of educational groups.

Following this action of the board of supervisors there developed such an avalanche of protesting letters and resolutions that the board of governors of the museum has appointed a special committee to investigate the matter. Chief among the protesting groups are the founding societies, who have a legal as well as scientific interest in the museum and who feel that the abrogation of their contract is ill advised and is working to the detriment of science in Southern California. Other protesting groups are the Southern California Academy of Sciences and the Federation of Natural Sciences of Southern California. To date some forty organizations have joined in this crusade against the crippling of science in the Los Angeles Museum.

It is gratifying to note with what high respect the research at the Los Angeles Museum is held by scientists throughout America, and it is hoped that the administering and legislating boards in control thereof will keep the museum out of politics and treat with due regard those scientists who are striving to create in this cultural center a respect-worthy museum.

*Committee of the Founder Societies  
of the Los Angeles County Museum  
of History, Science and Art*

A. W. BELL, Chairman

## BLOOD GROUP SPECIFIC SUBSTANCES AND BLOOD TRANSFUSIONS<sup>1</sup>

SINCE Landsteiner's classical investigations, the human race can be divided in four main groups according to their blood properties. The importance of the group-specific differentiation becomes apparent from the fact that not only the blood cells and spermatozoa but organs and tissue cells exhibit the group-specific characteristics. Such characteristics are also demonstrable in secreted and excreted. A complex carbohydrate-like substance with A-specific activity has been isolated by several investigators.

The specificity of this substance is shown by the "inhibition of agglutination" test as the combination of the A-specific substance, and the anti-A antibody present in normal human serum is usually not followed by visible precipitation. The subsequent addition of A blood cells to such a mixture constitutes the only way to prove that neutralization of the antibody has occurred; A cells are no longer agglutinated.

Blood of a homologous group is commonly used for transfusion purposes. Some thirty years ago, Ottenberg proposed that blood of group 0 could be used as universal blood because the blood cells of group 0 are not agglutinated by any normal human serum, except in very rare instances. Some large clinics use 0 blood in emergency cases and apparently are satisfied with their results. However, there are quite a few reports in the literature on severe reactions and even fatalities following the use of 0 blood in patients not belonging to group 0. These reactions are frequently attributed to the interaction of high-titered isoantibodies present in serum of group 0 and the cell properties of the patient. As a matter of fact, many institutions have abandoned the use of universal donor's blood.

In order to overcome the objection against the use of the universal donor as far as it is based on the presence of potent isoantibodies, we tried to add the isolated group-specific substances. At the beginning of our work only the A substance was available. The addition of the isolated A substance in amounts as small as 25 mg or less proved practically to be sufficient to neutralize the anti-A antibodies present in 500 cc of 0 blood.<sup>2</sup>

For the neutralization of the anti-B antibody present in 0 blood fluid, the B substance was needed. However, knowledge of the B-specific substance was very scant. Hallauer<sup>3</sup> had reported extracts of blood

<sup>1</sup> From the Buffalo General Hospital and the Department of Pathology and Bacteriology, University of Buffalo School of Medicine.

<sup>2</sup> E. Witebsky, N. Klendshoj and P. Swanson, *Jour. Infect. Diseases*, 67: 188-192, November-December, 1940.

<sup>3</sup> C. Hallauer, *Zeits. Immunitätsforsch.*, 83: 114, 1934.

exhibiting B activity. Very recently, Kin<sup>4</sup> has obtained a carbohydrate-like substance from human saliva of group B. We isolated a carbohydrate-like substance from gastric juice of human beings of group B, using a technique described by Goebel for the isolation of the A-specific substance from commercial peptone.<sup>5</sup>

Gastric juice was fractionated several times with 2½ volumes of alcohol in the presence of sodium acetate yielding a crude polysaccharide. Traces of protein were removed by means of Sevag's procedure using chloroform and butyl alcohol. After dialysis, a protein-free carbohydrate fraction was recovered by precipitation with 10 volumes of acetone.

This B-specific carbohydrate-like substance is serologically as active as the A-specific substance. Its chemical analysis will be reported elsewhere. It may be sufficient to state in this connection that there seem to be interesting quantitative differences in nitrogen and acetyl between the A and B substances.

Following the isolation of the B substance, the problem arose whether individuals belonging to group 0 possess an O-specific substance comparable to the A- and B-specific substances, or whether the O-group is characterized merely by the absence of A and B properties. It is known that certain normal beef sera, when treated with AB cells, agglutinate cells of group 0 stronger than cells of other groups. A carbohydrate-like substance was isolated from the gastric juice of human beings belonging to group 0 employing the same technique as for the isolation of the B-specific substance.<sup>6</sup> This substance inhibited the agglutination of 0 cells.

Whereas about 80 per cent. of human beings secrete large amounts of group-specific substances in the saliva and gastric juice, 20 per cent. fail to do so. The carbohydrate fractions isolated from the gastric juice of the non-secretor group proved to be serologically inactive.

After the A- and B-specific substances were made available, the neutralization of both the anti-A and anti-B antibodies present in 0 blood was attempted. The addition of a mixture of a few milligrams of A- and B-specific substances dissolved in 10 cc of saline solution proved to be sufficient for practical neutralization of the isoantibodies in 500 cc of 0 blood.<sup>7</sup>

Over 100 transfusions with "neutralized" 0 blood have been given in the Buffalo General Hospital mainly to patients belonging to groups A, B and AB

without necessitating determination of the blood group of the patient and sometimes even without cross matching. From the clinical standpoint, the results are satisfactory, although we are fully aware that the problem as such can not be solved from a statistical angle. It is furthermore understood that the addition of the group-specific substances can not bring about any other change than the neutralization of the isoantibodies present in blood fluid of group 0. There are still many sources of transfusion reactions left that are obviously not influenced by the addition of the group-specific substances to 0 blood.

ERNEST WITEBSKY

NIELS C. KLENDSHOJ

GENERAL HOSPITAL, BUFFALO, N. Y.

### CLINICAL ACHROMOTRICHIA<sup>1</sup>

DURING the past seven years I have been particularly interested in patients who needed endocrine therapy and who had gray hair. Soon after Lunde and Kringstad<sup>2</sup> and Morgan *et al.*<sup>3</sup> discovered that experimental achromotrichia may be due to a deficiency in a factor or group of factors belonging to the vitamin B complex, I began to administer relatively large doses of vitamin B complex products to gray-haired patients presenting metabolic problems and requiring thyroid treatment. Nine cases with endocrine dyscrasia received a vitamin B complex preparation<sup>4</sup> alone or together with endocrine substances. A marked change in the color of the hair was noted in all cases as a result of the above therapy. Definite darkening with many new natural colored hairs was striking evidence of the beneficial effects of the treatment. It is to be noted that the B complex preparation contained pantothenic acid.

In view of the fact that p-aminobenzoic acid has been reported to have chromatrichial activity for certain species<sup>5</sup> and is known to play a rôle in enzymatic pigmentation processes,<sup>6</sup> I investigated this substance clinically and wish to report the observations made during the past few months.

Fifty patients varying in age from 21 to 55 years with definite achromotrichia were picked at random. In 30 cases p-aminobenzoic acid was the sole therapy and in 20 cases endocrine products in conjunction with

<sup>1</sup> Preliminary report.

<sup>2</sup> G. Lunde and H. Kringstad, *Avh. Norske Vid.-Akad. Oslo, I. Mat. Ki.*, Nr. 1, 1938.

<sup>3</sup> A. F. Morgan, B. B. Cook and H. G. Davison, *Jour. Nutrition*, 15: 27, 1938.

<sup>4</sup> Bishop Laboratories' Elixir Be-vin Complex, dosage 5 ml twice daily, by mouth, or Solution B Complex 1 to 2 ml, subcutaneously.

<sup>5</sup> S. Ansbacher, *SCIENCE*, 93: 164, 1941; G. J. Martin and S. Ansbacher, *Jour. Biol. Chem.*, 138: 441, 1941.

<sup>6</sup> G. J. Martin, W. A. Wisansky and S. Ansbacher, *Proc. Soc. Exp. Biol. and Med.*, 47: 26, 1941; W. A. Wisansky, G. J. Martin and S. Ansbacher, *Jour. Am. Chem. Soc.*, 63: 1771, 1941.

<sup>4</sup> E. Kin, *The Journal of Chosen Medical Association*, 1940, 30: 4, 550-567, April 20, 1940.

<sup>5</sup> E. Witebsky and N. Klendshoj, *Jour. Exp. Med.*, 72: 6, 668-687, December 1, 1940.

<sup>6</sup> E. Witebsky and N. Klendshoj, *Jour. Exp. Med.*, 73: 5, 655-667, May 1, 1941.

<sup>7</sup> E. Witebsky, N. Klendshoj and P. Swanson, *Jour. Am. Med. Ass.*, 116: 2654-2656, June 14, 1941.

the acid were administered. After about two months of treatment I observed in all cases a marked darkening of the hair. The recently grown shafts appeared to be normally pigmented. It is my impression that an oral dose of 100 mg twice a day is ample to give results. The data seem to show that p-aminobenzoic acid has the same effect with respect to graying as the B complex preparation used in my earlier studies.

In view of the favorable results obtained I am continuing my experiments with a considerably larger series of cases in order to establish the optimum daily dosage of para-aminobenzoic acid. The detailed data will appear elsewhere.

BENJAMIN F. SIEVE

TUFTS MEDICAL COLLEGE  
AND BOSTON CITY HOSPITAL

## QUOTATIONS

### CHEMISTRY AND CANCER

ON our "Science in the News" page to-day is a collection of strange diagrams. They show the structures as the chemist conceives them of certain molecules known to produce cancer. It was for his brilliant fundamental study of these structures that Professor Louis Frederick Fieser of Harvard's chemistry department merited the Katherine Berkan Judd \$1,000 prize of The Memorial Hospital for the Treatment of Cancer and Allied Diseases.

No one can now predict whether this particular study will be the one that will lead to that goal of so many wearying researches—the prevention of malignant cell growth and its non-surgical treatment. But there can be little doubt that if the goal is to be reached it must be through a more complete understanding of the body's own normal and abnormal chemical processes.

Memorial Hospital, in its hearteningly handsome building on East Sixty-eighth Street, provides the occupants of its 250 beds with the most modern x-ray machines, ranging in size up to 1,000,000 volts, with the most up-to-date devices for applying the curative

radiation of radon gas, with the most skillful and aseptic surgery. But all these are drastic methods of dealing with a malignant growth that has already become dangerous. What about the cause? It is fortunate that beneath the same roof, under the direction of Dr. Cornelius P. Rhoads, men are working on the chemical root of the problem—subjecting experimental mice, for example, to the carcinogenic chemicals synthesized in Harvard's Converse Laboratory.

This correlation of the clinical and the chemical is one of the most encouraging aspects of modern cancer research. While doing all possible by present means for those already afflicted, scientists no longer base all their hopes on mysterious therapies whose modes of action are unknown. They are trying, step by difficult step, to reconstruct the chemical processes of life and ascertain the point at which those processes occasionally go off into the wilderness detour that we know as cancer. A substantial contribution toward that pathfinding is acknowledged in the award to Dr. Fieser, who thinks of the disease in terms of strange diagrams of molecular structure.—*The New York Times*.

## SCIENTIFIC BOOKS

### ORGANIC CHEMISTRY

*High Polymers*. Editorial Board, R. E. BURK, H. MARK and G. S. WHITBY. *Volume I. Collected Papers of W. H. Carothers on High Polymeric Substances*. By H. MARK and G. S. WHITBY. Illustrated. xix + 459 pp. New York: Interscience Publishers, Inc. 1940. \$8.50.

*Volume II. Physical Chemistry of High Polymeric Systems*. By H. MARK. Illustrated. vii + 345 pp. New York: Interscience Publishers, Inc. 1940. \$6.50.

IN the introduction to the series, "High Polymers," included in Volume I, the Editorial Board points out the technical and theoretical importance of high polymeric materials to the chemist. They set as their aim in this series the collection of our present knowledge in this field.

Volume I in the series, as the name shows, is a collection of the original papers of Carothers on high polymers and closely related topics. The volume contains a biography of Carothers; his papers reprinted under the headings: Studies on Polymerization and Ring Formation; Acetylene Polymers and Their Derivatives; Miscellaneous Papers; and a complete bibliography of Carothers' papers and patents. The value of the original papers has been increased by the preparation of an index which is a great aid to the student in locating specific topics.

Volume II in the series is essentially a revised edition of Professor Mark's "Allgemeine Grundlagen der hochpolymere Chemie." It contains a discussion of the fundamental concepts in general and physical chemistry which the author deems to be essential for the student who expects to work in the high polymer

field. Only a small portion of the book is devoted to the applications of these concepts to polymers, as the main object of the book is to provide an adequate background in physical chemistry for a proper appreciation of polymer problems.

C. S. MARVEL

UNIVERSITY OF ILLINOIS

*Catalysis—Inorganic and Organic.* By SOPHIA BERKMAN, JACQUE C. MORRELL and GUSTAV EGLOFF. xi + 1130 pp. Illustrated. New York: Reinhold Publishing Corporation. 1940. \$18.00.

THE importance of catalysts in chemical processes is phenomenal. The selection of catalysts and their preparation is still essentially an art; for this reason, the literature is extremely voluminous. This book comprises a stupendous compilation of material on heterogeneous and homogeneous catalysis, on various types of catalysts and their classification, conditions effecting activity, inhibitors, promoters, poisons and carriers. The arrangement is such that the reader readily may find either the facts about any catalyst or what catalysts may be used in any particular reaction. An enormous number of original references is given. The publication will be a welcome asset to the research chemist who desires an up-to-date handbook and reference work on catalysis.

ROGER ADAMS

UNIVERSITY OF ILLINOIS

*The Ring Index—A List of Ring Systems Used in Organic Chemistry.* By AUSTIN M. PATTERSON and LEONARD T. CAPELL. 661 pp. New York: Reinhold Publishing Corporation. 1940. \$8.00.

THIS book represents a collection of known parent ring systems, arranged in order from the simplest to the most complex. Widely accepted names, other preferred names and systematic names are given. An original reference to each ring is cited. Rules for numbering are discussed. The publication has involved a tremendous amount of time and thought. It will be most helpful to the organic chemical investigator who so frequently must struggle with the appropriate naming of compounds under study.

ROGER ADAMS

UNIVERSITY OF ILLINOIS

*The Theory of Organic Chemistry—An Advanced Course.* By GERALD E. K. BRANCH and MELVIN CALVIN. Illustrated. xix + 523 pp. New York: Prentice-Hall, Inc. 1941.

THIS book discusses the application of electronic structural theory to organic chemistry, with particular emphasis on the "resonance theory." The theories of

the structure of atoms and molecules are outlined, stressing the quantum mechanical development. The authors then consider the application of these theories to various physical properties and to the energy relations and rates of certain reactions of organic compounds. Some of the principal topics included are the dimensions of molecules, dipole moments, spectra, the strength of acids and bases, tautomerism, oxidation-reduction potentials, free radicals and the rates of such reactions as substitution at a saturated carbon atom and addition to unsaturated compounds.

The authors state in the preface that they have avoided "a collection and evaluation of the mass of existing theories" and that, "This policy necessitates giving our opinions undue prominence. Ideas have been ignored on the slight grounds that we do not agree with them." In view of this policy it is not surprising that the treatment appears dogmatic and that the correlation of experimental and theoretical material is often highly speculative. However, such an interpretation of the variety of ideas which have come to be known as the "resonance theory" should be a useful contribution, whether or not the reader agrees with the ideas.

The book is well set up, printed and bound and has a minimum of typographical errors.

C. C. PRICE

*Laboratory Outlines and Notebook for Organic Chemistry.* By CECIL E. BOORD, WALLACE R. BRODE and ROY G. BOSSERT, all of the Department of Chemistry of the Ohio State University. Illustrated. ix + 241 pp. 28 figs. New York: John Wiley and Sons, Inc. 1940. \$1.75.

THE authors have provided an excellent combination laboratory manual and record book suitable for use in either a year's course in organic chemistry, or by proper choice of experiments, a one semester's course. The manual represents a gradual development over a period of twenty years and shows care and forethought. Each experiment contains a preliminary discussion, experimental procedure and space for observations. Questions and problems with blanks for answers follow each experiment. The discussion is succinct, the directions clear and concise. The student is taught to think about organic molecules in three dimensions by actually constructing molecular models in the laboratory. The work is up-to-date, including among its 69 experiments sulfanilamide, organic plastics and an introduction to qualitative organic analysis. Helpful information concerning reagents, supplies and list of necessary apparatus is given. The packaging of the required amounts of chemicals for each student for each experiment is recommended as a means of avoiding waste, preventing congestion at

balances and reagent shelves and materially speeding up the laboratory work. The book is well printed and bound in attractively colored cardboard covers with a

spiral binding so that the pages lie flat, even though the book is folded back cover to cover.

R. L. SHRINER

## SPECIAL ARTICLES

### A STUDY OF HORMONAL FACTORS WHICH INFLUENCE THE PRODUCTION OF INSULIN<sup>1</sup>

THE present work had its origin in the attempt to devise a method for diagnosing diabetic "tendencies" prior to the time when positive diagnosis is obtained with the routine tests, as gathered from analyses of blood, urine and glucose tolerance curves. It seemed possible that stimulating carbohydrate metabolism in "normal" subjects and in those with diabetic "tendencies" might reveal differences in hormonal relationship which could, perhaps, be detected by urine analysis.

Some preliminary work was necessary before embarking upon the more ambitious part of our program; and the present report deals with several interesting observations.

In a study of carbohydrate metabolism, involving the activity of hormones, we had to consider, aside from insulin, the diabetogenic hormone (D.H.) and the insulintropic substance (I. S.).<sup>2</sup>

Methods of extraction and methods of estimation are given by Best, Haist and Ridout and by Campbell and Keenan.<sup>3</sup> Methods of estimation are based upon the following facts: the injection of an extract containing D. H. will decrease the amount of insulin in the pancreas, whereas the injection of an extract containing I. S. will increase the insulin content.

For the assay of the diabetogenic and insulintropic effects, the rat method of Best<sup>3</sup> was used, ten male albino rats of 200-300 g in weight being injected intraperitoneally for a period of 14 days. The insulin assay in the pancreas of rats was carried out according to the directions of Marks,<sup>4</sup> using 40 mice.

Based on the work of Campbell and Keenan,<sup>3</sup> a

<sup>1</sup> We are indebted to the following: Dr. Erwin Schwenk, Schering Corporation, for estradiol, progesterone and testosterone; the U. S. Vitamin Corporation, N. Y., for stilbestrol; Professor H. M. Evans, Professor Abraham White and Dr. Oscar Riddle for samples of prolactin; and Dr. David Klein, Wilson Laboratories, for supplies of pituitary glands. We wish to thank Dr. Julius Rosenthal, director of the Pathological Laboratories of the Welfare Hospital, for his interest in our work.

<sup>2</sup> The "diabetogenic hormone" tends to increase the amount of sugar in the blood and tends to decrease the production of insulin in the pancreas. The "insulintropic substance"—there is some debate as to whether we are dealing with a hormone—stimulates the production of insulin.

<sup>3</sup> C. H. Best, R. E. Haist and J. H. Ridout, *Jour. Physiol.*, 97: 107, 1939; J. Campbell and H. Keenan, *Canadian Chemical Process Industry*, 23, 280, 1939.

<sup>4</sup> H. P. Marks, cited in "Biological Standardization" by J. H. Bura, pp. 91, etc.

fractionation procedure for the anterior pituitary was developed. These authors describe the preparation of an active extract of D. H. We were hopeful that the anterior pituitary would also yield an active extract of I. S.; and we therefore prepared fractions from the residue obtained after complete extraction of D. H. by a 10 per cent. salt solution. Four fractions prepared and tested were the following: 1. An alkaline extract of the glandular tissue which had previously been extracted with a solution of NaCl (fraction 2); 2. A globulin-like material, soluble in salt solution and insoluble after dialysis; 3. A fraction recovered from the solution remaining in the dialyzing bag after dialysis; 4. The combined dialysates after elimination of NaCl. In each case the fractions were concentrated *in vacuo* and precipitated with alcohol-ether.

Using 10 rats per fraction, amounts were injected equivalent to 10 g of the original anterior pituitary gland. From the table it can be seen that fraction 3 exhibits a slight diabetogenic effect, and that fraction 1 shows insulintropic activity. The other two fractions were found to be inactive.<sup>5</sup>

Another phase of the subject was suggested by the work of Marks and Young,<sup>6</sup> who reported that crude prolactin preparations exhibited marked insulintropic effects, although they were of the opinion that the activity was not due to prolactin itself. Using highly purified samples of prolactin, we found, on the contrary, that they show definite diabetogenic activity (see Table 1).

The same authors pointed out that estrone, unlike testosterone, produces a definite insulintropic effect.<sup>7</sup> We were able to confirm, to a certain extent, and to enlarge this observation (see table). The synthetic estrogen, stilbestrol, shows even more insulintropic activity than estradiol; and progesterone, and more particularly, testosterone, show diabetogenic effects.

A fact worthy of comment is that an insulintropic effect has been obtained using such widely divergent substances as a protein fraction of the anterior pituitary on the one hand, and estradiol and stilbestrol on the other. The activity of the latter substances may perhaps be explained by stimulation of the anterior pituitary.

<sup>5</sup> According to Campbell and Keenan, fraction 2 should have contained D.H.

<sup>6</sup> H. P. Marks and F. G. Young, *Lancet* II, p. 710, 1940.

<sup>7</sup> See, also, E. Cantilo, *Endocrinology*, 28: 30, 1941, who describes the beneficial effects of estrogens in menopausal diabetes.

TABLE 1

Substance	Amount injected	No. of rats	Total weight of rats (in g.)	Insulin Un. per 100 g. body weight	Per cent. change
<b>Anterior pituitary fractions:</b>					
Control	...	10	2,900	0.36	...
Fraction 1	518 mg	10	2,200	0.64	+ 77
Fraction 2	180 mg	10	2,100	0.38	0
Fraction 3	1129 mg	10	2,050	0.26	- 28
Fraction 4	63 mg	10	2,350	0.34	0
<b>Prolactin preparations:</b>					
Control	...	10	2,340	0.42	...
Evans (sheep)	400 I.U.	10	2,740	0.00	- 100
Evans (sheep)	480 I.U.	7	1,550	0.02	- 98
White (ox)	300 I.U.	10	2,550	0.08	- 81
Riddle (ox)	300 I.U.	10	2,530	0.22	- 48
<b>Steroids and stilbestrol:</b>					
Control	...	10	2,080	0.43	...
Estradiol	12.6 mg	9	2,160	0.54	+ 19
Estradiol	14.0 mg	10	2,000	0.51	+ 19
Stilbestrol*	11.2 mg	8	1,710	0.67	+ 56
Stilbestrol*	14.0 mg	10	1,800	0.62	+ 44
Progesterone	12.6 mg	9	2,730	0.39	- 7
Progesterone	14.0 mg	10	2,690	0.36	- 16
Testosterone	14.0 mg	10	2,350	0.29	- 31
Testosterone	14.0 mg	10	2,870	0.27	- 37

\* The weight loss is due to toxicity.

## SUMMARY

1. Insulinotropic effects were obtained with a protein fraction of the anterior pituitary, with estradiol and with stilbestrol.

2. Varying diabetogenic effects were obtained with highly purified prolactin preparations, with progesterone, with testosterone and with a fraction, probably also protein, from the anterior pituitary.

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# CURE OF EGG-WHITE INJURY IN RATS BY THE "TOXIC" FRACTION (AVIDIN) OF EGG WHITE GIVEN PARENTERALLY

RECENTLY<sup>1</sup> it has been shown, in experiments dealing with dietary egg-white injury, that raw or commercial egg white can be supplanted by a particular fraction of egg white (avidin). Previously<sup>2</sup> the spe-

cific biotin-binding capacity of this substance had been established by the yeast-growth method,<sup>3</sup> according to which biotin, in the presence of avidin, becomes unavailable for yeast cells and growth therefore ceases.

It has been found<sup>1</sup> that instead of the 20 to 30 per cent. of raw or commercial egg white needed in the experimental rations to produce egg-white injury in rats, from 0.03 to 0.07 per cent. of avidin is equally effective.

In view of these experimental results the presence of egg-white injury has been explained by the fixation of biotin to avidin in the intestine, the probable non-absorption of the avidin-biotin (AB) complex and its consequent excretion with the feces.

This assumption is borne out by experiments in which the presence of the avidin-biotin (AB) complex in the feces was directly tested. In the absence of avidin, biotin is present in tissues and in feces in free and in bound form, the latter being liberated only by intensive hydrolysis.<sup>4</sup> The avidin-biotin complex, on the other hand, is easily split by steaming for a short time (30 to 60 minutes) at 100 C. By the yeast-growth method no difference could be found in the biotin content of feces before and after steaming (4 to 5 micrograms per gram) when rats were fed a normal stock diet. By the same method it was found that rats fed a diet containing cooked egg white plus avidin, however, excreted only negligible amounts of free biotin (in one experiment 0.1 microgram per gram), whereas after the feces had been steamed large additional amounts of biotin became free (4.4 micrograms per gram in the experiment cited).<sup>4</sup>

In order to answer the question how avidin may act in parenteral administration a series of special experiments was required.

Concentrates of avidin were prepared<sup>5</sup> according to the procedure described by Eakin, Snell and Williams.<sup>6</sup> The biotin-binding capacity of each concentrate was tested quantitatively by the yeast-growth method.

To learn their effect on egg-white injury the avidin preparations were thoroughly mixed with pulverized, cooked dried egg white in varying amounts in different experiments which corresponded, on the basis of bio-

<sup>1</sup> R. E. Eakin, E. E. Snell and R. J. Williams, *Jour. Biol. Chem.*, 136: 801, 1940.

<sup>2</sup> E. E. Snell, R. E. Eakin and R. J. Williams, *Jour. Am. Chem. Soc.*, 62: 175, 1940.

<sup>3</sup> By variation of the normal diet and by feeding a pure meat ration we have so far been unable to detect in the feces of rats AB from which biotin could be liberated by steaming unless egg white was also present in the diet.

<sup>4</sup> The authors wish to express their thanks to Professor R. J. Williams and his collaborators, of the Department of Chemistry, University of Texas, for sending a generous supply of avidin concentrates. Other concentrates were prepared in the Laboratory of the Babies and Childrens Hospital of Cleveland.

<sup>5</sup> The designation of the "toxic" protein of egg white tentatively proposed as *avidalbumin* (P. György, C. S. Rose, R. E. Eakin, E. E. Snell and R. J. Williams, *SCIENCE*, 93: 477, 1941) has been modified by the Texas group to *avidin*, because this protein does not entirely fit into the classification of an albumin. Additional details have now been published (R. E. Eakin, E. E. Snell and R. J. Williams, *Jour. Biol. Chem.*, 140: 535, 1941). In the present and previous studies avidin concentrates have been used, as pure crystallin avidin has not been available.

tin-binding capacity, to the equivalent of from 0.6 to 2.4 gm of egg white per 10 gm of the diet. This mixture was substituted for the original commercial egg white in the experimental diet<sup>6</sup> used for the production of egg-white injury. Control experiments were carried out with rations containing (1) cooked egg white without the addition of avidin and (2) commercial egg white. Additional special groups of rats fed these two control rations were injected with avidin dissolved in normal saline solution; the daily amounts varied in terms of biotin-binding capacity from the equivalent of 0.3 to 1.2 gm of egg white.

Avidin mixed with the food proved to be "toxic" even in the small doses of one third to one fifth the amount used in previous experiments.<sup>1</sup>

Avidin given parenterally, however, did not seem to exert any toxic effect and was unable to prevent improvement in the manifestations of egg-white injury when cooked egg white was substituted for the original commercial egg white in the diet. Pathological symptoms seemed to disappear more rapidly and the gain in weight appeared more extensive in these animals than in the control rats which received the diet containing cooked egg white without the simultaneous injection of avidin. This impression was substantiated by experiments in which rats kept on the original egg-white injury producing diet<sup>6</sup> were treated, when they were severely "injured," with daily injections of avidin preparations dissolved in normal saline solution. It has been demonstrated that avidin concentrates which are "toxic" when they are given enterally may be of high therapeutic value when they are administered parenterally. The selected examples given in Table I illustrate this conclusion.

TABLE I

Group	Diet containing	Avidin administered	Weight response (gm)	Effect on egg-white injury
A	Cooked egg white	By mouth for 12 days: Rat No. 6344 Rat No. 6441 Rat No. 6442	- 3 - 7 - 7	Intensified Intensified Intensified
B	Commercial egg white	Parenterally for 12 days: Rat No. 5845 Rat No. 6097 Rat No. 6289	+ 37 + 42 + 23	Almost cured Almost cured Almost cured

An explanation of this paradox must take into consideration the presence of biotin in the avidin preparations. These concentrates contain a large excess of free avidin and, in addition, bound biotin (AB). In one of our preparations the analysis of the daily dose revealed the presence of free avidin in an amount which would inactivate 17 micrograms of biotin as well as the presence of 1.2 micrograms of biotin already bound (AB). It can be assumed that, whereas under

the conditions prevailing in the intestine AB is a stable compound and biotin is thus inactivated, in the parenteral medium a split occurs which liberates the concealed biotin and as a result the biotin acts therapeutically.

The smallest content of biotin found thus far in an avidin preparation which brought about complete cure of egg-white injury in rats when it was administered parenterally was 0.1 microgram in a vehicle of 180 micrograms of avidin preparation. This amount is not far from the therapeutic rat unit (0.04 microgram).<sup>7</sup>

Further experiments are needed to throw light on the special factors which promote liberation of bound biotin from the avidin-biotin (AB) complex under parenteral conditions.

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### BIOTIN AND THE GROWTH OF NEUROSPORA

FIVE races of *Neurospora* were found to be biotin-deficient organisms and to require for growth the presence of biotin in the medium. None grew more than slightly in a mineral-glucose solution containing asparagine,<sup>1</sup> or on the same medium solidified with agar which had been purified by extraction with 5 per cent. pyridine and ethyl alcohol.<sup>2</sup> The addition to these media of peptone, potato extract,<sup>1</sup> agar extract<sup>2</sup> or pure biotin methyl-ester<sup>3</sup> permitted normal growth. Thiamin was ineffective.

The following races were used: *N. sitophila* 56.2 and 56.6; *N. tetrasperma* S<sub>1</sub> and S<sub>6</sub>; *N. tetrasperma* J<sub>1</sub>, carrying the dominate lethal E; *N. tetrasperma* C<sub>4</sub> and C<sub>8</sub>, carrying the recessive lethal d. A wild strain of *N. sitophila*, collected in Bermuda by Dr. F. J. Seaver, was also tested.

Twenty-five ml quantities of a basal mineral-glucose solution containing asparagine in 125 ml flasks were inoculated with small bits of mycelium. A thin mat of mycelium 3 or 4 mm in diameter formed in the liquid within seven days, but no further growth occurred. Sub-cultures into the same medium grew about as well but no better. The basal solution was varied by the addition of thiamin, potato extract, agar extract or pure biotin methyl-ester. The addi-

<sup>1</sup> P. György, C. S. Rose, K. Hofmann, D. B. Melville and V. du Vigneaud, *SCIENCE*, 92: 609, 1940.

<sup>2</sup> Wm. J. Robbins and K. C. Hamner, *Bot. Gas.*, 101: 912-927, 1940.

<sup>3</sup> Wm. J. Robbins and Roberta Ma, *Bull. Torrey Bot. Club*, in press.

The biotin methyl-ester was furnished through the courtesy of Dr. Vincent du Vigneaud.

<sup>6</sup> P. György, *Jour. Biol. Chem.*, 131: 733, 1939.

tion of thiamin had no effect on the growth of any of these strains. They all grew rapidly in the solutions with potato extract, agar extract or pure biotin. *S<sub>1</sub>* and *S<sub>2</sub>*, grown together produced abundant conidia and perithecia in these solutions. Mature ascospores were observed in the solutions with potato extract and agar extract but not in those with the pure biotin. *56<sub>a</sub>* and *56<sub>b</sub>*, non-conidial races, produced perithecia and mature ascospores in all these solutions. *C<sub>1</sub>* and *C<sub>2</sub>* together produced abundant conidia and perithecia, but no ascospores were formed, which is normal for a mating of these recessive lethal races. *J<sub>1</sub>* formed conidia and abundant perithecia. A small number of ascospores matured in cultures of this lethal. The Bermuda strain was unisexual and produced abundant conidia. Protoperithecia formed in the solutions with biotin and potato extract. The presence of biotin in potato extract<sup>4</sup> and agar extract<sup>2</sup> has been reported.

The effect of biotin on *S<sub>1</sub>* and *C<sub>1</sub>* was studied in agar cultures containing the basal solution solidified with 1 per cent. purified agar. Tubes were inoculated with one drop of a suspension of conidia in distilled water. Both strains grew very little on the purified agar but grew rapidly with the production of abundant conidia when pure biotin, agar extract or neopeptone was

added. Higher concentrations of biotin, 0.05 microgram per culture, or agar extract equivalent to 5 per cent. agar, caused a larger number and more rapid development of the protoperithecia. Cultures of *C<sub>1</sub>* lost their typical lethal appearance and grew like normal *N. tetrasperma* when agar extract, equivalent to 1 per cent. agar, was added, but showed all the features characteristic of the lethal form when agar extract equivalent to 5 per cent. agar was added.

Although all the strains tested were biotin-deficient and grew little or not at all without the addition of that growth substance to the medium, a synthetic medium containing biotin as the sole growth substance was entirely satisfactory for the *56<sub>a</sub>* and *56<sub>b</sub>* races only. Additional factors of some type appear to be necessary for free production of ascospores by the combinations *S<sub>1</sub>* and *S<sub>2</sub>*, *C<sub>1</sub>* and *C<sub>2</sub>*, and the bisexual *J<sub>1</sub>* race. A detailed report of this work will be published.

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## SCIENTIFIC APPARATUS AND LABORATORY METHODS

### A PRECISION FINE ADJUSTMENT FOR STANDARD MICROSCOPES

EXPERIENCED microscopists have long maintained that correct interpretation of three-dimensional structures, particularly of biological materials, can only be obtained by continual refocusing. For illustration purposes drawing can suggest the third dimension, but this is not real evidence, since interpretation is involved.

Single photomicrographs involve interpretation since the third dimension is not indicated. However, series of photomicrographs taken with constant differences of focus can show all the changes in appearance that the microscopist sees. Though such series can not be made with the unmodified standard microscope, they can be made with the Graton<sup>1</sup> microscope and with the standard microscope fitted with a lever and a tangent screw. Illustrations made with such a microscope are shown in a paper now in press by Hamly and Watson.<sup>2</sup>

The instrument used in making the above-mentioned illustrations was designed some three years ago, and since then many series of photomicrographs have been

made with it. The figure shows part of the Zeiss microscope<sup>3</sup>, model #1c (1906) and the modifications made. Most modern microscopes could be so changed; the microscope must have a rigid stand and a fine motion with low lag, smooth operation and low friction.

While the scale indicates 0.1μ divisions, springiness and lag can make small movements meaningless unless certain precautions are taken. They are: (a) the microscope must be moved upward rather than downward by the tangent screw; (b) the microscope should not even be touched during focusing; (c) preliminary visual adjustments should be made carefully until the operator is certain that the principal optical cross section is included in the series. Good series are made with differences of 0.2μ, but this is close to the practical limit caused by residual springiness and lag.

All photographs of the series should be made on the same plate or film, so that all peculiarities of emulsion, development and fixation will be common. Variable exposures can be eliminated by the use of an automatic shutter, or stop watch, provided the source of light does not vary. Series of exposures on one plate or film are easily made in a camera fitted for a sliding plate holder such as the Zeiss Multiplex which the author uses.

The precision motion is not much help in ordinary visual work except in making measurements. How-

<sup>4</sup> Wm. J. Robbins, *Bot. Gaz.*, 102: 520-535, 1941.

<sup>1</sup> L. C. Graton and E. B. Dane, *Jour. Opt. Soc. Amer.*, 27: 355-376, 1937.

<sup>2</sup> D. H. Hamly and J. H. L. Watson, *Trans. Roy. Soc. Canada*. In press, 1941.

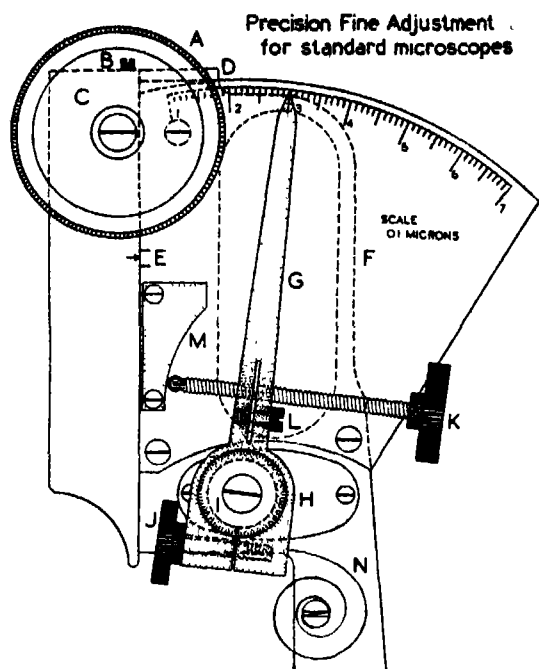


FIG. 1. A—Coarse adjustment; B—Friction regulating screw for coarse adjustment; C—Coarse motion slide bar; D—Cover plate for fine motion; E—Fine motion limit marks; F—Back of microscope limb; G—Lever and scale indicator; H—Thick split sleeve; I—Free end of fine motion knob; J—Locking screw; K—Precision fine motion adjustment screw; L—Friction controlling screw for K; M—Tangential thrust block; N—No lag spring. Scale engraved with 0.1μ divisions. Motion adapted to Zeiss Microscope Model 1c (1906).

ever, the normal use of the fine motion<sup>1</sup> is not handicapped and whenever desired the precision motion can be engaged by locking with screw. The "feel" of the fine motion is not changed by the precision modification.

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#### CARRIAGE FOR A LARGE NUMBER OF SPECIMENS DURING PARAFFIN INFILTRATION

THE effort usually involved in the simultaneous handling of a considerable number of specimens during paraffin infiltration can be materially reduced by means of the following device. The dimensions given here (Fig. 1) are adapted to the usual staining vessels, but can of course be adjusted to individual requirements. The carriage is constructed of fine-meshed copper milk screen. The partition strips are notched and fitted together like the separators in an ordinary egg carton, and drops of solder applied to a few of the joints where necessary. A suitably bent piece of copper window screen placed in the paraffin

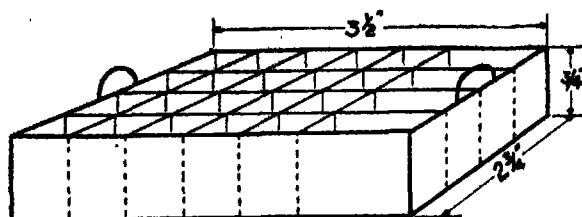


FIG. 1. Tissue carrier made of copper milk screen.

vessel is desirable in order to support the carriage a short distance from the bottom. The entire carriage is immersed in the paraffin bath and can be transferred through as many changes as the size of the tissues may require. The same series of paraffins can be used repeatedly.

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#### DRAINAGE IN THE LITTLE-WELLS APPARATUS FOR GAS ANALYSIS

LITTLE and Wells<sup>1</sup> have described an apparatus for student use in the analysis of samples of respiratory air. Two burettes of the type described have been tested in this laboratory. As noted by the authors, great care was taken to insure complete drainage, but because of the narrow bore of the stopcock excessive shaking was required which resulted in the breakage of one piece of apparatus. The addition of  $\frac{1}{2}$  per cent. isopropyl alcohol to the saline solution used for leveling, and modification of the technique so that the absorbent solutions were washed down each time with approximately one cc of saline solution have eliminated this difficulty.\* The accuracy of the technique in the hands of student operators remains unchanged.

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<sup>1</sup>J. Max Little and Herbert S. Wells, *SCIENCE*, 2340, 425, 1939.

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## SUCCESSES AND FAILURES OF EXPERIMENTAL PSYCHOLOGY<sup>1</sup>

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It is customary to claim for psychology that, while it has a long history as a branch of philosophy, it can be excused for a considerable degree of immaturity because of its youth as a branch of experimental science. As the decades go by this excuse becomes less and less convincing. There are several very active and successful sciences, as physical chemistry and bacteriology, which are really younger than experimental psychology. If these sciences have made more rapid progress than psychology, the reason may be that they are working with phenomena that lie further from everyday experience, so that their discoveries are more striking. Other reasons can be suggested.

Possibly psychology has undertaken a harder job, a more complicated problem to unravel—or possibly psychologists have not been making good use of their time. At any rate psychology should be able by now to point to substantial achievements won by use of experimental methods, along probably with a number of failures which may be quite instructive in themselves. It would be too much to attempt here and now to answer the question, how much has been achieved by experimental psychology in the half century or more of its existence. We can only touch a few high (and low) spots in the hope of conveying some idea of the progress of psychology as it appears to those who are actively interested in pushing it forward.

<sup>1</sup> Annual Sigma Xi address, Indiana University, March 18, 1941.

### BEGINNINGS OF EXPERIMENTAL PSYCHOLOGY

No precise date can be assigned for the beginnings of our science. The year 1860 is as suitable as any. Before that time, and during all the earlier part of the nineteenth century, physicists and physiologists had been occasionally making experiments which could properly be included in psychology. There were many experiments on the senses and sense perception. Just about 1860, Helmholtz and Fechner organized these earlier results and suggested laboratory methods for the further study of such problems. Almost simultaneously Darwin gave a start toward the scientific interest in animal behavior and child development, matters which have become very important to the psychologist. Darwin was soon followed by Francis Galton, who ranks as one of our pioneers for his work on individual differences, tests and correlations. In Germany, Helmholtz and Fechner were followed by Wundt and other leaders who established psychological laboratories in some of the universities, beginning about 1880. These laboratories were adjuncts of the departments of philosophy, and their first directors were professors of philosophy. This was generally true as the new movement spread to other countries, though in a few universities the psychological laboratory was at first attached to the laboratory of physiology. In general the physiologists were fully occupied with other developments in their rapidly growing science.

The American universities were prompt to adopt the new psychology. In the eighties and nineties a large number of laboratories were established from the Atlantic to the Pacific. The Indiana laboratory was one of the first. Except for scattered studies the birth of experimental psychology was nearer 1890 than 1860. Just about now many of our laboratories are celebrating their fiftieth anniversaries, and the American Psychological Association, organized by the young protagonists of the new movement, is to have its jubilee in 1942.

The motive animating these pioneers was partly the desire to see psychology emulate the older sciences and partly a sense of the futility of endless discussion unsupported by definite data. As Wundt said in 1862, psychology was properly a natural science but had made little progress since Aristotle. Its stagnation was due to its lack of scientific methods and to the metaphysical problems in which it was enmeshed. If psychology would turn its attention to questions answerable by natural science methods it would be on the road to progress.

We can not complain of the attitude of the philosophers. Without some support from them, those laboratories could not have appeared in such rapid succession. The philosophers were indeed rather

sceptical as to the scope of experimental psychology. It could perhaps shed some useful light on minor questions but could scarcely be expected to solve the great problems of body and mind and the theory of knowledge. Probably they were right, and probably Wundt was right as well in holding that psychology should turn its attention to new problems. Psychology had to explore and find its own distinctive problems as it became acquainted with its proper field.

Scepticism was not confined to the philosophers. Many natural scientists believed the field of mental phenomena and operations much too intangible and elusive for genuine experimentation. "How can you possibly experiment on the mind?" was a common query. "You can not control your variables." Some work could be done on the senses, but such work was more appropriate for physiology than for a science of the soul or mind. True enough, anything like a mystical or transcendental conception of the mind rules out or scares away the experimental psychologist. But he has found other ways of conceiving the mental activities of the individual. Though there is some real difficulty in controlling the variables the project is not so hopeless as it seemed at first. The attempt must be made, anyway, unless we are willing to resign ourselves to continued ignorance.

The psychologists went to work in their new laboratories. There was much work still to do on the senses, and here the physiologists and physicists have continued their efforts, the psychologists however contributing a respectable share toward the progress that has been made. There have been failures as well as successes, but we will pass on to other problems that are perhaps more characteristic of psychology.

### PSYCHOPHYSICS

Fechner, as much as any one, is entitled to be called the father, or grandfather, of experimental psychology. Primarily a physicist, he was also a philosopher of a rather mystical turn who believed in the existence of two worlds, the physical and the psychical. What he called psychophysics was an attempt to demonstrate definite relations between the two worlds. When light stimulates the eye or sound the ear the stimulus belongs in the physical world, the sensation in the psychical world. Living at a time when the conservation of energy was a new discovery and when the transformation of energy from one physical form to another was being investigated, Fechner asked whether some equation could not be worked out between the energy of the stimulus and the intensity of the sensation. As the stimulus increases the sensation increases but seemingly not so fast. Weber's law, which Fechner named after its discoverer and further tested out and verified to a reasonable extent, was interpreted

by Fechner as showing that the sensation increases as the logarithm of the stimulus intensity. So he had a psychophysical law. The experiment was a success in his own view.

But Fechner did not succeed in convincing the scientific world that his law was truly psychophysical. It seemed more likely to be purely physiological. For proving his point to his contemporaries or successors, his experiment was a distinct failure. Nevertheless as an empirical law, subject indeed to certain limitations, the Weber-Fechner finding has proved of considerable importance, both in science and in engineering. And the psychologists are deeply grateful to Fechner for the skill and care with which he worked out experimental methods for testing his law. These methods have proved to be invaluable in a variety of problems.

#### THE REACTION TIME EXPERIMENT

One of the oldest psychological experiments can be seen in operation on the athletic field. The contestants in a foot race line up, are told to be ready, and then get the signal to go. If the time from this signal to the first forward movement of the runner were measured, it would differ from one individual to another and probably average about one fifth of a second. Take this performance into the laboratory and simplify the conditions, substituting a finger movement for the forward spring of the whole body, and you have the reaction time experiment. What scientific use can be made of so simple a thing?

The experiment was first used by Helmholtz in 1850 in the hope that it would furnish a measure of the speed of conduction in the sensory nerves of man. He had succeeded in measuring the speed in the motor nerves of an animal. He could tell when the nerve current reached a muscle by the resulting muscle twitch, but he had no way of telling exactly when a sensory nerve current reached the brain. The best he could do was to instruct his human subjects to react with the hand as soon as they felt a weak electric shock applied to some part of the skin. The farther this part of the skin was from the brain, the longer the sensory nerve conducting to the brain and the more time should be required for the whole reaction. The experiment was only moderately successful, there was so much variation in the reaction time, due doubtless to variation in the brain process involved. At least, the variability of the brain action in so simple a performance is a fact worth knowing.

Another use was soon suggested for this experiment. Complicate the performance and see how much additional time is required. Instead of a single, uniform stimulus to which the subject always makes the same reaction, let him understand that there are to be two stimuli, a red and a green light, and that

when the red appears he is to move his right hand; when the green, his left hand. It takes him about one tenth of a second longer. The brain has an additional task to perform—or two additional tasks, that of distinguishing between red and green, and that of choosing the correct hand for the reaction. Therefore, it was inferred, the extra one tenth of a second is the time required by the brain for the acts of discrimination and choice.

The hope of certain experimenters, back in the sixties, seventies and eighties, was by use of this experiment to determine the time required for each elementary mental operation, like discrimination, choice, recognition, association. The idea was to insert extra elements of performance into the reaction and to see how much extra time was required for each element. The plan broke down because the subject did not passively wait for the stimulus and then go through the supposed sequence of elementary acts. Instead, he was active before the stimulus arrived, preparing himself for the total act he had to perform. When the act was completely defined in advance, as in the simple reaction, the subject's preparation was very definite, but when two possibilities were in prospect, he could not prepare himself so completely. His reaction was slower because his preparation was less complete, and the extra time required was not merely the time of an inserted elementary act.

Obviously, the reaction time experiment was a failure, so far as the original purposes of the experimenters were concerned. Yet the results were instructive in a number of ways. They showed the importance of what we now call "preparatory set," the state of readiness for an anticipated reaction. And reaction time has proved to be a useful tool in investigating various problems. When Cattell, working in Wundt's laboratory about 1885, found by the reaction time method that familiar short words were perceived and read as quickly as single letters, the result threw much light on the psychology of perception and on the best method of teaching a child to read.

#### EXPERIMENTS ON LEARNING, MEMORY AND MOTOR SKILL

The early psychological experimenters saw no way of attacking the "higher mental processes," but in the eighties Galton in England and Ebbinghaus in Germany showed that memory and related processes could be brought into the laboratory. It was Ebbinghaus who invented nonsense syllables for use in memory experiments. He presented a series of such totally unrelated items for the learner to connect and memorize. Entirely new connections had to be established, as would not be the case with a sequence of

familiar words. By this device Ebbinghaus succeeded to a certain extent in controlling an otherwise disturbing variable. He obtained a characteristic "curve of forgetting," showing that the loss of barely learned material is rapid at first and slower as time goes on. He varied the conditions of learning and demonstrated the operation of a number of significant factors. His work put new life into the laboratory and started a line of investigation which continues fruitfully down to the present, with many ramifications. On the whole his experiment was a decided success.

On one respect, however, the original experiment of Ebbinghaus must be called a failure. He apparently assumed the learning process to consist in an automatic establishment of associations between the nonsense syllables. The learner was giving careful attention to the material, to be sure, but the connections were supposed to be formed by a simple mechanical process and strengthened by a mere repetition of this process. Later experimenters, by varying the method and obtaining more complete data, have found that the learning process is by no means simple and automatic. The learner is intensely active, grouping the syllables, noting their positions and their similarities and differences, and often reading some meaning into the syllables. The first experiments had left a false impression of the nature of the learning process. Objection has also been raised to the use of nonsense syllables because of their artificiality, but this objection is not very serious because in the first place the method is easily extended so as to employ meaningful material, and in the second place, no matter how artificial the material, the learner is not made artificial, and the various ways in which he attacks the artificial task bring out very clearly the characteristics of an intelligent learner.

An important next step in the experimental psychology of learning was taken here at Indiana University in the nineties, when Bryan and Harter conducted their pioneer experiments on the acquisition of skill. The telegrapher's skill was the particular topic of their investigation, which was followed up in the next decade by Book's study of the process of learning to use the typewriter. These experiments can be counted among the eminently successful ones and they inaugurated another long series of investigations, by many experimenters in various places, dealing with the problem of how motor skill is acquired.

In learning to typewrite, for example, one must first become familiar with the keyboard so as to strike each letter promptly and accurately as it is reached in spelling out a word. When the learner can do this he assumes he has mastered the art, in principle, and needs only to increase his speed. As he continues he is surprised to find himself performing in unexpected

ways. He catches himself in the act of writing a familiar word without spelling it out. His fingers go through the necessary sequence of movements as an integrated pattern, no longer as a series of discrete acts. These spatial-motor patterns are called "higher units." The telegrapher also, after considerable practice, hears a whole sequence of clicks from the sounder as an auditory pattern. He hears word units rather than letter units or single clicks. Higher units are built up in any skilled performance. Some of the best examples are found in ordinary speech. To speak a word demands a sequence of speech movements—one for *c*, one for *a* and one for *t*, in pronounced the word *cat*—and the little child learns by degrees to build up this unit. It becomes so much a unit that later he can scarcely break it up into its parts. He hears it as a unit, too.

Within the general field of experiments on learning the next development was the study of problem-solving and learning in animals. Here again the work began in the nineties. The original interest was in the evolution of animal intelligence, but a more definitely psychological problem soon came into view. The learning process seemed to be fundamentally the same in man and the higher animals, and the fundamentals were more clearly revealed in the simpler behavior of animals than in man with his intellectual and linguistic devices for rapid learning. On the whole these animal experiments must be counted among the successes of psychology, though it would not be difficult to find particular studies that have started with false assumptions and led temporarily to false conclusions.

About 1900 a new type of experiment on learning was originated in Russia by the physiologist, Pavlov. This was the conditioned reflex experiment. A dog's saliva will start to flow, not only when food is placed in his mouth (a natural reflex) but also when a bell is rung, provided the bell has repeatedly been rung just before he receives his food in a familiar laboratory situation. Evidently this conditioned reflex is a learned response. It was so regarded by Pavlov, but he was not particularly interested in it from this angle. To him it was an indicator of the physiological processes of excitation and inhibition going on in the brain. He insisted that his experiment was definitely physiological and not in the least psychological. Nevertheless the psychologists appropriated the experiment as a new lead in the study of learning. It might go to the bottom of things and provide an explanation of all forms of learning. They have tried the experiment on human as well as animal subjects and have varied it in many ways. The more recent experimenters find, however, that conditioning is by no means so simple a process as was first supposed. It is not a mere attachment of an old response to a new stimulus

but is, rather, the building up of a new pattern of response adjusted to a particular combination of stimuli. It depends on good adjustment to the total situation. And the process of becoming conditioned sometimes involves trial and error and even insight. In short, though the external conditions are greatly simplified as compared with ordinary life, the subject himself is not simplified but is free to utilize any of his devices for meeting a novel situation.

#### THINKING

After a start had been made in experiments on learning and memory, the next question was whether any feasible experiment could be contrived for studying the thought processes. Some information on problem solution by men and animals could be obtained from the learning experiments, since the subject's first trial in a new task calls for the solution of a novel problem. What is usually called the "thought experiment" dates from early in the present century. The subject is assigned a problem to solve and reports what he can of his procedure. Time is taken and other objective records may be made of his behavior. This rather rudimentary experiment has yielded some interesting results but can not be called an outstanding success. At first interest was centered on the question, what mental images were used in thinking. Some subjects reported visual pictures "before the mind's eye," other subjects reported mostly inner speech, others reported that when a new idea was just dawning on them it came neither in words nor in pictures but just as a bit of meaning, an "imageless thought." The results were rather intangible and the whole enterprise languished after a few years of great activity. One definite finding was that the "set" for the task, which had been found important in reaction time experiments, was a potent factor also in thinking and intellectual work. The thinker adjusts himself to his task and so steers his thoughts more or less definitely in the right direction.

A little later the behaviorists suggested that thought was probably a motor activity. It might consist largely of slight movements of the speech organs. At first the child thinks aloud, we may suppose, and later cuts down the amplitude of his speech movements while still thinking with his mouth and larynx, though perhaps also with his hands and feet. This theory challenged the experimentalist to detect any slight speech movements that might occur during silent thought. Hopefully he applied recording instruments to the tongue and to the neck over the larynx, and he obtained evidence of some muscular activity during thought but nothing that seemed characteristic of different thoughts. His instrumentation in this first period was crude and lacking in sensitivity.

Nowadays amplified muscle potentials afford a much better index of slight motor activity, and this method does show some muscular activity in the arm, for example, when the subject thinks of lifting a weight. This line of investigation is still in its early stages and we can not predict how much it may show regarding the dynamics of the thought process.

#### MOTIVES AND EMOTIONS

An important problem under the head of emotion can be put as follows: What is the state of the organism in fear, rage, joy and the various emotions? We have a partial answer from physiological and psychological experiments. As to the motivation of behavior we have some rather fundamental findings from the animal laboratory. This whole line of work is difficult and has scarcely made satisfactory progress.

Mental abnormalities, the neuroses and psychoses, are due to emotional disturbance and conflict of motives more than to intellectual disorder. So the psychiatrists believe, but they say they can find little of value in the experiments of psychologists on motives and emotions. Freud in particular denied that he could get anything at all from the experimental psychologist, but he may not have tried very hard. He was himself in a sense an experimenter in applied psychology. His experiments were clinical, intended to discover what theories would work well in the treatment of neurotic patients. Early in his career he was momentarily disturbed to find that his female patients were likely to fall violently in love with him during the long course of a psychoanalysis. His hypothesis was that these patients were not in love with him as an individual, exactly, but rather as a father substitute, and he inferred that the emotional attachment would flatten out if he maintained a professional attitude and allowed the patients to use him as a father substitute while working out their emotional problems. The hypothesis seemed to work very well in many cases, though it must be admitted that the success of the treatment does not demonstrate the truth of Freud's conceptions, since somewhat different hypotheses would predict the same result.

Freud put out an enormous number of hypotheses, or assertions, applicable not to clinical practice alone but to everyday life, and it is strange that more of them have not been tried out by psychologists. Recently certain experiments on conflict and frustration, more or less definitely suggested by Freud's writings, have found their way into the laboratory with interesting and promising results. Undoubtedly many of Freud's dicta would not stand up in an experiment, at least in their original form, though they might be suggestive.

Pavlov's "experimental neurosis," an outgrowth of

his conditioned reflex experiment, appears at present to be a promising lead for the laboratory man, perhaps more promising than most of the Freudian hypotheses. We can not expect a dog's or a rat's neurosis to be identical with that of a human being, and we can not hope to carry over the results of the animal laboratory directly into the psychiatric clinic. But something has been gained when we know definite procedures for creating a condition of nervous instability in an animal, especially if we can also discover how to bring him out of that condition.

#### CHILD DEVELOPMENT

The question, how an abnormal condition arises, is part of the broader problem of tracing the development of the individual and discovering the factors that promote, impede or modify development. This is a problem now being fruitfully attacked by many psychologists by the method of following the child through from birth to maturity. Tests and laboratory methods are used to give an exact knowledge of the course of development and to reveal differences between children in relation to their parentage and environment. But a developmental experiment in the full sense is not easily carried out with human subjects. The psychologist must not introduce experimental factors which might result in mental deficiency or abnormality. He could introduce conditions such as would probably improve the child's development, but he seldom has sufficient control over the child and family to insure a clean-cut result. Attempts are being made, however, and no doubt we can expect increasing success as the work continues.

#### SURVEY EXPERIMENTS AND TESTS OF HYPOTHESES

The complaint is often heard, as we have already found, that laboratory conditions are too much unlike those of everyday life to throw any light on life and behavior. The complaint is only partially justified. We must distinguish two types of experiment. There is the exploratory type which surveys a field of phenomena in the hope of turning up something that may be of significance. The keen observer, in well-known historic instances, has obtained leads from such surveys that have carried him along to important discoveries. It is decidedly worth while for the psychologist to discover how the individual acts in a

variety of conditions, including certainly the conditions of everyday life.

The other type of experiment is pointed up to check some definite hypothesis; and here there is no need to keep the conditions lifelike if only they are such as will provide a clean test of the hypothesis. The hypothesis itself should have some bearing on everyday life, but the question of its truth or falsity is sometimes best put to the test by introducing conditions that are artificial or at least unusual. This is true of some of the best experiments in the older sciences. What is the use, some one might ask, of experimenting to see how a bullet and a feather fall in a vacuum, since in nature they never do fall in a vacuum? The answer is that the experiment provides a definite check on a proposed law of falling bodies. In applying the results to the fall of bodies in the air a correction must of course be made for the resistance of the air, and in the same way a correction will often be necessary when the findings of the psychological laboratory are applied in the clinic, the schoolroom or the athletic field. Just as the engineer must make experiments of his own to determine how the general laws of physics will work out in a complex system like an airplane moving at high speed, so the applied psychologist needs to take over from the experimentalist not his results only but his attitude and general method.

One who has lived through a large share of the history of experimental psychology is sometimes asked whether the present generation of experimenters, so greatly exceeding in number the small band of the old pioneers, measures up to their level in quality of work, and whether any substantial body of scientific knowledge has been built by the assiduous labor of half a century and more. My own answer to both these questions is in the affirmative. My impression of the younger men is that they stand comparison very well with the older group. And any one who takes the trouble to compare their background with that provided by the older psychology will soon realize that there has been a great advance. The results of experimental psychology are not as yet well systematized, and there are large gaps in our knowledge, but the present state of the science is a challenge to the younger men rather than any ground for discouragement.

## OBITUARY

### VICTOR JOLLOS

1887-1941

DR. VICTOR JOLLOS, a leading student of heredity and mutation, died suddenly at Madison, Wisconsin,

July 5, 1941, following a short period of ill health. He was born in Odessa, Russia, on August 12, 1887, the son of Gregor Jollos and Rosa Jurowaky Jollos.

Dr. Jollos spent his entire youth in Germany, where his parents had established residence before his birth.

He received his high-school education in Heidelberg and Berlin, and studied at the Universities of Munich and Berlin under R. Hertwig and M. Hartmann, both of whom influenced him considerably. In 1910 he received his Ph.D. degree in zoology from the University of Munich, and in 1918 he completed the *Medizinisches Staatsexamen*, and received the German state license for the practice of medicine, following conclusion of his medical studies at the University of Berlin.

Serving as research assistant at the Robert Koch Institute, Berlin, during 1912-1914, Dr. Jollos became acting head of the institute's protozoology department in the latter year. After the war, during which he did medical work, he was appointed research assistant in the Kaiser Wilhelm Institut f. Biologie, Berlin-Dahlem, continuing in that position until 1925. From 1921-1925, he also served as *privatdozent* for zoology at the University of Berlin.

Upon invitation of the Egyptian Government, Dr. Jollos became professor of zoology and head of the zoology department, which he organized and administered for four years, at the newly created Egyptian University, Cairo, in 1925. While in Egypt, he also was a member of the board of examiners for the medical and veterinary medicine schools in Cairo, served as special adviser to the Egyptian Ministry of Agriculture on sheep and poultry breeding experiments, and was president of the Royal Zoological Society of Egypt.

Returning to Germany in 1929, he became associate professor of zoology in charge of protozoology at the University of Berlin, and was appointed to head a special research laboratory at the Kaiser Wilhelm Institut f. Biologie. Dr. Jollos and his family left Germany after the rise of the Hitler régime, and after a brief interval at the University of Edinburgh, came to the United States in 1934, acquiring American citizenship in 1939.

Under auspices of the Committee in Aid of Displaced German Scholars and the Rockefeller Foundation, Dr. Jollos received a temporary appointment as visiting professor of zoology and genetics at the University of Wisconsin. After expiration of this appointment he was named Carl Schurz memorial lecturer at the University of Wisconsin for a short period, and continued research in genetics under a grant-in-aid from the National Research Council until 1939. In the spring of 1937 he undertook a lecture tour of several eastern universities, speaking at the departments of zoology of Yale University, the Johns Hopkins University, the University of Rochester, N. Y., and Amherst College. He had made his home in Madison since his arrival in this country.

Dr. Jollos's interests in biology were unusually broad

and profound. During his almost 30 years of research experience, he worked on varied problems of genetics, parasitic and general protozoology and general biology. His early investigations were primarily in protozoology and later, when certain problems of genetics and evolution commanded his attention, much of his work was done with the Protozoa. His most important research work in genetics dealt with problems of the rôle of environmental conditions in the production of hereditary alterations. This was foreshadowed as early as 1913, when he published a preliminary report of experiments dealing with the acquisition of resistance to poison by pure lines of infusoria.

Perhaps Dr. Jollos's best-known work in genetics is that on *Dauermodifikationen*. In a series of papers, beginning in 1921, he showed that certain external conditions change particular characters of the organism, and that the change reappears in succeeding generations in a gradually lessening degree until it finally disappears. Experiments on Protozoa and Metazoa demonstrated that the change is cytoplasmic, and suggested that it is gradually overcome by the genes. This pioneer work, which opened up an important new field of research, is now recognized as classical.

During recent years he gave much attention to the origin and nature of mutations, seeking especially to test further the view he had earlier announced, but which other investigators had failed to confirm, that certain environmental factors, such as heat, which can produce mutations, may also have a directive influence on the character of the change. Being himself unable to reproduce his initial results, Dr. Jollos sought to improve the experimental technique he had used so as to bring under control some environmental factors which he suspected were responsible for the discrepancies. Unhappily the opportunity he so earnestly desired to pursue this work further never came to him.

Close associates of Victor Jollos recognized his fine scholarly character and the extraordinary extent of his scientific and general knowledge. He was inclined to work alone in his methodical, persevering way, seeking to apply every possible experimental test to the ideas which flowed freely from his fertile and severely logical mind. He provided a fine stimulus to advanced students, and willingly gave his time in their behalf.

Dr. Jollos published more than 50 books, pamphlets, articles and papers during his lifetime, most of them dealing with specific phases of modification, heredity, protozoology and general biology. His immense knowledge of biological literature found expression in a number of monographic reviews which were published in different German handbooks. He wrote seven papers and one book since coming to this country, his

last published work being a book on the fundamentals of heredity with special emphasis on mutations and modifications. It appeared in 1939.

Dr. Jollos also left two unpublished books, one of which, a history of protozoology, he was working on at the time of his death, while the other, a general history of science and biology, tentatively entitled "Problems of Life," was written in 1936.

In 1920 Dr. Jollos married Ilse Raven, an accomplished pianist and teacher, who, with their two daughters, Miss Eva Jollos, a Madison newspaper reporter, and Miss Inge Jollos, a University of Wisconsin student, is now living in Madison, Wisconsin. His mother; a sister, Dr. Nadia Jollos, and a brother, Dr. Waldemar Jollos, in Zurich, Switzerland, also survive him.

R. A. BRINK

UNIVERSITY OF WISCONSIN

### DEATHS AND MEMORIALS

DR. WILLIAM FRANCIS GANONG, from 1894 until his retirement with the title emeritus in 1932 professor of botany and director of the botanical garden of Smith College, died on September 9, at the age of seventy-seven years.

DR. WALTER GRANGER, curator of fossil mammals of the American Museum of Natural History in New York and a member of the staff for more than fifty years, died on September 6. He was sixty-eight years old.

DR. ERNEST JULIUS BERG, who retired last June with the title emeritus from the professorship of electrical engineering at Union College and as dean of

the department of engineering, died on September 9 at the age of seventy years. He was engineer and consulting engineer of the General Electric Company from 1892 to 1909.

HARRY GRINDELL-MATTHEWS, the Welsh inventor, died on September 11 at the age of sixty-one years. In recent years he had been engaged in research on air defense. He had worked on radio, the synchronization of action in sound films, on wireless telephoning and on wireless control of torpedoes, airplanes and motor boats.

A CORRESPONDENT writes: "Miss Clyde Schuman, 420 Riverside Drive, New York City, is writing a biography of Mary Swartz Rose, until her death last February a member of the faculty at Teachers College, Columbia University, and one of the country's foremost authorities on nutrition. After graduating from Denison University in 1901, Dr. Rose attended Mechanics Institute, Rochester, N. Y., then taught in Fond du Lac, Wisconsin, for three years. She then studied at Teachers College and at Yale. In 1909 she joined the staff at Teachers College, becoming full professor in the department of nutrition in 1921. Miss Schuman will be grateful for letters from persons having notes on her lectures or comments on her educational and scientific procedures; from those who knew her as fellow-student; from those serving with her on national and international committees; and from friends who may have pertinent information. Full credit will be given for material used and any material submitted will be promptly copied and returned."

## SCIENTIFIC EVENTS

### THE BRITISH COUNCIL

THE report of the British Council covering the year ended March 31 has been made public. According to an abstract in *Nature*, the council has recognized two main duties, first, the defensive role in the resistance to and disapproval of charges brought by German and Italian propaganda and, second, the positive mission of carrying to other countries a knowledge of the contribution which Great Britain has made and still makes towards the science of life and government.

The chief methods adopted by the council for this purpose are the formation of new or the encouragement of existing British cultural centers abroad, and the council is now responsible for British institutes in Malta, Cyprus, Palestine, Egypt, Iraq, Spain and Portugal. Most of the anglophil societies encouraged by the council are now found in Latin America although before the war the council was in touch with no less than two hundred and fifty such societies, many in France, Germany, the Netherlands and Scandinavia.

The council also encourages British schools abroad as well as English studies in foreign schools and universities, and throughout these institutions and elsewhere the knowledge of the English language. Competitive scholarships, valued at £250, are awarded to well-qualified, post-graduate students from foreign countries and from the Empire.

Such activities have been inevitably modified by the war. One of the council's main tasks has been to build up in the premises of the anglophil societies of British institutes and also in foreign universities and other institutions general libraries of English books and to this has been added the presentation of scientific and technical works to specialist libraries abroad. A book export scheme has been initiated to encourage the sale abroad of British books of cultural importance as well as a book review scheme intended to secure the review of British books in foreign newspapers and periodicals.

A small fortnightly publication has been issued

since March, 1939, under the title "Britain To-day," containing generally an editorial and three articles written for the foreign reader on subjects which may be expected to be of interest to him. Reference is also made to the work of the council in regard to films, particularly the commission of documentary films on carefully chosen subjects dealing with British life and achievements and the commission or acquisition of films intended for educational purposes abroad or describing scientific or technical achievements which it is desired to make known abroad. An Advisory Scientific Committee has also been formed which it is intended should work in three or more panels, one under the chairmanship of Sir William Bragg dealing with pure science, a second under the chairmanship of Sir Edward Mellanby dealing with medicine and a third under the chairmanship of Sir William Larke dealing with engineering. Sir William Bragg is also chairman of the Advisory Scientific Committee as a whole.

Previously, the council's interest in scientific publicity was shown chiefly in cooperation with the British Medical Information Service, the dispatch of a number of scientific and learned periodicals and books abroad including a complete section of the South American Book Exhibition, the preparation of a Spanish hand-book of British industrial practice, in conjunction with the British Standards Institution, and the presentation of equipment to a hospital in Sana'a and to a bacteriological institute in Chile.

#### PREFERENCE RATING FOR RESEARCH SUPPLIES AND EQUIPMENT

THE *Journal* of the American Medical Association writes that the great importance of scientific research to the defense program has just been recognized by granting a high defense priority rating to equipment needed by research laboratories. The Director of Priorities, E. R. Stettinius, Jr., signed an order which became effective on August 30 and remains effective until February 28, 1942, granting the priority rating of A-2 to such equipment. There are in the United States some two thousand research laboratories which use small quantities of about five thousand chemicals and require in their work twenty-five thousand different instruments.

Any laboratory having difficulty in securing essential materials for scientific research and wishing to qualify for the A-2 rating should apply to the Office of Production Management, Chemical Branch, Washington, D. C., on form PD-88. In its application the laboratory must state the type of service rendered or products manufactured. The Office of Production Management has entered into an agreement with the National Academy of Sciences whereby the Division of Priorities will have the benefit of the advice of the

academy with respect to all applications received. When a laboratory files an application, it should state the number of copies of the order it desires so that it may apply the rating to deliveries to it by its suppliers if necessary and enable its suppliers in turn to apply the rating to deliveries to them by their sub-suppliers. Each order issued to a laboratory will bear a serial number assigned by the Division of Priorities.

If a laboratory is unable to obtain some essential material even with the A-2 rating, it should file an application with the Priorities Division on form PD-1; then, provided the research product is considered sufficiently important, the Priorities Division will issue an individual preference rating certificate, assigning a higher rating to a particular delivery of specified material. Further details concerning this matter may be obtained from the Priorities Division of the Office of Production Management.

#### THE NEW YORK AQUARIUM

THE New York City Aquarium at Battery Park will be closed at the beginning of October and most of its exhibits will be removed temporarily to the Zoological Park in the Bronx.

At a recent meeting of the Board of Estimate it was proposed to transfer \$21,775 from the aquarium budget to the budget of the New York Zoological Society, this sum to cover the cost of providing facilities in the park for some of the fish, aquatic birds, etc., now housed at the aquarium. Opposition to the proposed transfer of budget funds was voiced by George McAneny, spokesman for professional, historical and civic organizations. In common with other speakers opposing it, he feared that the first step was being taken toward ultimate demolition of the ancient landmark. Park Commissioner Moses, however, suggested its retention as a restored Fort Clinton, provided the city were able to appropriate the \$182,000 needed for such restoration. Kenneth Dayton, director of the budget, stated that the city would have no funds available for the construction of a building to replace the aquarium.

At this meeting representatives of the New York Zoological Society distributed copies of an architect's drawing showing a possible exhibit to be established at the Zoological Park to house some of the aquatic animals, such as penguins, now in the aquarium. The exact location of the proposed exhibit was not disclosed, but it was indicated that a site had been chosen at a central point in the park.

It is reported that plans are now under consideration for the ultimate establishment at Coney Island of a marine garden, similar to the one recently established in Florida. The plan calls for its construction through some form of authority that will charge an admission fee to support the enterprise.

## POSITIONS UNDER THE FEDERAL GOVERNMENT

In order to staff federal agencies with the thousands of qualified persons needed to carry on defense and regular activities, the Civil Service Commission is announcing examinations in virtually every field of the social and physical sciences. The positions listed below represent some of the many opportunities for government employment.

**Industrial Specialists:** \$2,600 to \$5,600 a year. Persons are needed who know industrial methods and processes from first-hand experience in industrial management, planning, engineering, cost accounting, business analysis or research.

**Economists:** \$2,600 to \$5,600 a year. Separate employment lists will be established in each grade and for each specialized branch into which the entire field of economics may be subdivided. A 4-year college course in economics is required, with professional research or college teaching.

**Research Chemists, Explosives Chemists:** \$2,600 to \$5,600 a year. Qualified persons experienced in chemical investigative work involving the use of recently developed specialized techniques and instruments are being sought for such agencies as the Bureau of Mines in the Department of the Interior and the Bureau of Agricultural Chemistry and Engineering in the Department of Agriculture. A 4-year college course in chemistry or chemical engineering and appropriate experience are required.

**Physicists:** \$2,600 to \$5,600 a year. Positions are available in the planning, direction and conducting of investigations or research work in every branch of physics. Four years of college study, with a major in physics, and experience in research or the direction of scientific investigations in a specialized branch of physics must be shown.

**Pharmacologists:** \$2,600 to \$4,600 a year. Applicants who show a 4-year college course with major study in pharmacology, pharmacy, toxicology, biochemistry, or a closely related subject, and scientific investigative experience may qualify.

**Meteorologists:** \$2,000 to \$5,600 a year. For the junior grade, a 4-year college course with major study in meteorology, physics, engineering, or a closely related subject, plus experience for the higher grades, is required for these highly technical positions.

**Technical and Scientific Aids:** \$1,440 to \$2,000 a year. Many government agencies are needing persons trained to do research and testing in radio, explosives, chemistry, physics, metallurgy and fuels. Technical or scientific experience, defense training courses and college study may meet the requirements.

**Engineers and Engineering Aids:** \$1,620 to \$5,600 a year. Every field of engineering work is represented. As examples, engineering aids are needed in photogrammetry and topography—engineers for construction, welding and safety work, as well as for research and developmental work on farm machinery and the industrial utilization of surplus agricultural products. Chemical engineers are particularly needed who have had experience with the unit

processes of chemical engineering useful in the extraction of manganese, tin, chromium or mercury. Persons with engineering experience and those who have completed engineering study, undergraduate or graduate, are urged to apply. Defense training courses in engineering subjects may satisfy a part of the educational or experience requirements.

**Junior Soil Conservationists** (\$2,000 a year) are needed to work with the technicians in the Soil Conservation Service of the Department of Agriculture and with farmers in planning farms and applying conservation measures. Applicants must have completed an appropriate 4-year college course in agriculture.

For all these positions, and many more, applications will be accepted for several months. No written tests are given, but applicants are rated on their experience, education and training. The Civil Service Commission's representative in any first- or second-class post office can supply further information about these examinations, as well as the proper application forms. Applications should be sent direct to the Civil Service Commission, Washington, D. C., where they will be rated as soon as possible after receipt.

## MELLON INSTITUTE TECHNOCHEMICAL LECTURES

A SERIES of lectures on current trends in the American Chemical Industry will be presented by technologic specialists of Mellon Institute of Industrial Research during 1941-1942. These discourses, which will be delivered on alternate Thursdays, from 11:30 A.M. to 12:30 P.M., throughout both semesters, in the auditorium of the institute, will be open to all students of industrial chemistry and chemical engineering in the University of Pittsburgh, as well as to members of the institute.

October 2, Dr. E. R. Weidlein, "Economic Problems of the Chemical Industry."

October 16, Dr. F. W. Adams, "Status of the Manufacture of Heavy Chemicals."

October 30, J. M. Russ, "Significance of Industrial Synthetic Organic Chemistry."

November 20, Dr. H. J. Rose, "Industrial Opportunities in Fuel Technology."

December 4, Dr. W. A. Gruse, "Recent Scientific Advances in Petroleum Technology."

January 8, Dr. R. L. Wakeman, "Status of the Manufacture of Plastics."

January 22, Dr. E. E. Marbaker, "Vitreous Enamels—A Key Industry."

February 12, Dr. H. E. Simpson, "Present Problems in Building Materials Technology."

February 26, R. H. Heilman, "Economic Importance of Heat-Insulating Materials."

March 5, Dr. G. H. Young, "Major Problems in Corrosion."

March 19, Dr. R. O. Johnson, "Utilization of Important Mineral Wastes."

April 2, Dr. P. J. Wilson, Jr., "Progress in Industrial Waste Disposal."

April 23, R. D. Hoak, "Major Problems in Sanitation."

May 7, Dr. H. B. Meller, "The Maintenance of Health in the Chemical Industry."

### THE WISCONSIN MEETING OF THE NATIONAL ACADEMY OF SCIENCES

THE autumn meeting of the National Academy of Sciences will be held at the University of Wisconsin on October 13, 14 and 15. There will be an address of welcome on Monday morning, October 13, by President Clarence A. Dykstra, of the university, and a response by Dr. Frank B. Jewett, president of the academy. In the afternoon there will be a reception by President and Mrs. Dykstra.

The public lecture will be given in the evening by Dr. Zay Jeffries, of the Nela Park Laboratory at Cleveland of the General Electric Company. Preced-

ing the lecture there will be an informal subscription dinner at the Wisconsin Union. A reception is planned for Tuesday evening, followed by a second subscription dinner. Each day luncheon will be served at the Wisconsin Union. On the afternoon of Wednesday a visit is planned to the Forest Products Laboratory.

Scientific sessions are planned for each morning. Members of the academy who expect to present papers or to introduce guests presenting papers are requested to send to Dr. Joel Stebbins, Washburn Observatory, University of Wisconsin, the full titles and three abstracts of each paper. In accordance with the custom of the academy a maximum of fifteen minutes will be allowed for the presentation of each paper.

Members of the committee of arrangements are: B. M. Duggar, *chairman*; C. E. Allen, Gregory Breit, E. B. Fred, L. R. Jones, C. K. Leith, Joel Stebbins, E. B. Van Vleck, all of the University of Wisconsin, and, *ex-officio*, F. E. Wright, home secretary of the academy.

## SCIENTIFIC NOTES AND NEWS

THE American Association for the Advancement of Science meets in Chicago from September 22 to 27 in conjunction with the celebration of the fiftieth anniversary of the founding of the University of Chicago. The program consists mainly of the symposia and addresses, full accounts of which have been printed in the issues of *SCIENCE* for July 4 and August 15. The executive committee of the association will meet on Sunday, September 21. From September 27 to 29 following the meeting of the association there will be an academic festival of the University of Chicago, the principal events of which will include an alumni assembly, a service of thanksgiving and commemoration, a reception of delegates, a festival concert and a convention, at which honorary degrees will be conferred.

DURING the recent visit of Dr. Arthur H. Compton, professor of physics of the University of Chicago, to South America as director of the Andean Cosmic Ray Expedition, honorary degrees were conferred on him by the University of San Marcos at Lima and by the University of Arequipa. He was made an honorary member of the Peruvian Chemical Society and a corresponding member of the Brazilian Academy of Sciences and of the Academy of Exact Sciences at Lima.

THE Franklin Medal, awarded for the first time by the Scientific Society of San Antonio, Texas, was presented at the annual dinner of the society to Colonel Charles F. Craig, in recognition of his dis-

tinguished work in science. Dr. Craig retired in 1938 as professor of tropical medicine and head of the department at the Medical School of Tulane University, New Orleans.

ON the occasion of the final exercises on September 17 of the celebration of the centenary of Fordham University the degree of doctor of science was conferred on Dr. Gustav Ernst Frederick Lundell, chief chemist of the National Bureau of Standards, and on Dr. N. H. Heck, chief of the Division of Terrestrial Magnetism and Seismology of the U. S. Coast and Geodetic Survey.

DR. B. F. KINGSBURY, emeritus professor of histology and embryology at Cornell University, has been appointed guest professor in the department of anatomy of the University of North Carolina.

DR. ADOLF MEYER, who retired on September 1 as Henry Phipps professor of psychiatry and director of the Psychiatric Clinic of the Johns Hopkins Hospital, is succeeded by Dr. John C. Whitehorn, formerly physiological chemist and director of laboratories at McLean Hospital, Belmont, Mass., since 1938 professor of psychiatry at the Medical School of Washington University, St. Louis.

DR. WALTER REECE BERRYHILL has been elected dean of the School of Medicine and chairman of a newly established division of medical sciences of the University of North Carolina. He has been acting dean of the Medical School since the resignation a year ago of Dr. W. de B. MacNider.

At the University of Rochester the following promotions have been announced: Dr. Curt Stern, from associate professor of zoology to professor of experimental zoology, and Dr. Sherman C. Bishop, from junior professor of zoology to professor of vertebrate zoology. Promotions from assistant to associate professor are: Dr. Sidney W. Barnes, physics; Dr. David R. Goddard, botany; from instructor to assistant professor, Dr. Richard H. Goodwin, botany; Dr. John W. Green, mathematics; Dr. Orrington E. Dwyer, chemical engineering, and Dr. John B. Buck, zoology. Dr. John D. Coakley, research fellow in psychology, has been appointed to an instructorship, and Harrison D. Stalker, teaching assistant in zoology, has been made research assistant. Dr. Harry D. Bouman has been appointed assistant professor of psychology and Dr. Gerhard Dessauer, research associate in physics. New instructors are: Dr. Warren D. McPhee, chemistry; Dr. Lowry B. Karnes, geology; Dr. Joseph B. Platt, physics; Dr. Hobart M. Smith, zoology, and Dr. Howard H. Rostorfer, physiology (vital economics).

PROFESSOR WALTER G. WHITMAN, head of the department of chemical engineering of the Massachusetts Institute of Technology, has been appointed oil consultant for the Office of Production Management. He succeeds Dr. Robert E. Wilson, president of the Pan-American Petroleum and Transport Company, New York, a director of the American Chemical Society, who has resigned after serving thirteen months.

W. G. TAGGART, since 1913 assistant director of the Agricultural Experiment Stations of the Louisiana State University, has been named director. He succeeds Dr. C. T. Dowell, director since 1928, who becomes professor of agronomy on the faculty of the College of Agriculture.

T. R. RHEA, since 1924 a member of the staff of the General Electric Company, Schenectady, N. Y., has been appointed engineer of the new chemical section in the department of industrial engineering of the company. The section has been established to carry on activities that heretofore have been a part of the work of the mining section.

DR. B. D. EVANS, assistant director of the Royal Observatory at Hong Kong, has been made director.

THE Committee of the British Privy Council for the Organization and Development of Agricultural Research has appointed Major James Keith, Professor F. T. Brooks, Professor D. Keilin, Professor J. A. Scott Watson and Professor C. R. Harington as members of the Agricultural Research Council.

DR. W. RALPH SINGLETON, associate geneticist at the Agricultural Experiment Station at New Haven,

has leave of absence to enable him to accept an invitation to conduct courses in genetics during the fall term at the University of Minnesota. He will take the place of Professor H. K. Hayes, who is on a mission to Peru.

PROFESSOR W. WARREN STIFLER and Professor Theodore Soller, of the department of physics of Amherst College, have been given leave of absence for one year to enable them to engage in work for national defense. Professor Stifler will conduct special courses in optics at Columbia University and Professor Soller will engage in research at the Massachusetts Institute of Technology. In their absence from Amherst Professor Claude R. Fountain, professor at Peabody College for Teachers at Nashville, Tenn., has been appointed visiting professor of physics.

DR. JAY L. LUSH, of the department of animal husbandry of the Iowa State College, will devote the autumn to a journey to South America. He has accepted the invitation of G. G. Carneiro, director of the Agricultural College of Minas Geraes, Brazil, to be guest lecturer at that school. While there he will give lectures on breeding systems, and will conduct conferences on animal breeding and on research methods and problems of animal husbandry.

THE autumn meeting of the American Society of Mechanical Engineers will be held from October 12 to 15 at Louisville, Ky.

THE annual meeting of the Midwest Museums Conference of the American Association of Museums will be held at Fort Wayne, Ind., on October 17 and 18.

THE eleventh annual meeting of the American Malacological Union was held in Thomaston and Rockland, Maine, from August 26 to 29. Norman W. Lermond, director of the Knox Academy of Arts and Sciences, Thomaston, was convention host. A special feature of the program was a symposium on "Methods of Collecting and Preserving Mollusks" of which Dr. B. R. Bales, Circleville, Ohio, was chairman. Frank Collins Baker, University of Illinois, was elected president and Dr. Louise M. Perry, Asheville, N. C., vice-president.

A SYMPOSIUM on "Life in High Altitudes and Aviation Medicine" will be presented on the morning of September 23 in conjunction with the fiftieth anniversary celebration of the University of Chicago. The speakers include Dr. Carlos Monge, professor of medicine at the University of San Marcos, Lima, Peru; Dr. David Bruce Dill, Major, Air Corps, United States Army; Dr. A. C. Ivy, professor of physiology and pharmacology at the Medical School of Northwestern University, and Dr. E. S. Guzmán Barrón, assistant professor of biochemistry at the Lasker Foundation of the University of Chicago.

THE London correspondent of the *Journal* of the American Medical Association reports that the British Minister of Health has appointed an expert committee to review the present and future requirements of vegetable drugs in the light of empire consumption and trade and facilities for cultivation within the empire; to consider the steps which should be taken to secure organization of cultivation and collection, and to make recommendations. This committee has now presented an interim report which differentiates two groups of drugs—a long-term and a short-term group. It is held to be unlikely that any long-term policy will materially affect the supply of drugs during the present emergency, as the period preceding production would be too long. The committee considers that in the United Kingdom attention should be concentrated on the production of agar, dill, belladonna, Irish moss, colehiicum, digitalis, ergot, male fern, liquorice root, hyoseyamus, peppermint, psyllium, sphagnum moss, stramonium, dandelion root and valerian. Arrangements have been made by the Ministry of Health to extend the areas of cultivation of certain extremely important drugs. The Royal Botanic Gardens have arranged with the National Federation of Women's Institutes to organize the collection of ten important herbs in each county, making a total of thirty herbs throughout the country.

IN the administration and instruction building of the Montreal Botanical Gardens there was opened on August 28 a new laboratory to be known as the John Dearness Laboratory for Plant Pathology. Dr. Dearness attended and delivered the opening address. He was presented by Dr. Marie-Victorin, head of the department of botany of the University of Montreal. This laboratory has been established under the auspices of the Faculty of Sciences and the Botanical Institute connected with the university. The event was included in the program of the closing afternoon of the summer meeting of the Mycological Society of America which this year was held in the Montreal dis-

trict with headquarters in Macdonald College. Dr. Walter Snell, of Brown University, vice-president of the society, participated in the proceedings.

WE learn from *Nature* that in regard to the co-ordination of the universities and research institutions in India with the development and extension of industrial research, attempts are being made to obtain the cooperation of the universities in preparing the combined list of industrial researches completed, in progress and proposed to be undertaken in government laboratories, universities and research institutions in India. Publication of an annual combined list is contemplated. The report on the work of the Industrial Research Bureau also refers to the coordination of universities and research institutions. The number of laboratories in India capable of undertaking industrial research work is limited, and after considerable attention had been given to the matter it has been decided to provide funds to be allocated to selected institutions for the payment of grants to workers engaged in research falling within the programs to be arranged on the recommendations of the Board of Scientific and Industrial Research.

A WIRELESS to *The New York Times* states that a decree of discrimination against Jewish physicians and surgeons has been announced at Vichy. The proportion of Jews to non-Jews must not exceed two per cent., as is already fixed for the legal profession. Exemptions are provided for Jews who have rendered signal service to France. Before the exodus of Jews from Central and Southeastern Europe in the years immediately preceding the war, it was computed that Jews in France represented 2.4 per cent. of the total population. The law relates to Jews of French nationality. Alien Jewish physicians were barred from practicing several months ago. Thus laws affecting Jews are being made operative in the unoccupied zone of France. In the occupied zone, the Nuremberg "ghetto laws" are applied.

## DISCUSSION

### AN INTRODUCTORY COURSE IN BASIC PHYSICS

IN connection with Professor S. R. Williams's article in your issue of April 25th, entitled "Physicists Needed for National Defense Work," Professor Williams has suggested that I should call attention to the introductory course in basic physics which has been given for several years at Stevens Institute of Technology. This course was organized to present basic physics in a rigorous quantitative way. Calculus is used as soon as it is needed, which is almost from the start, and is currently taught in the mathematics de-

partment. Engineering naturally provides the best quantitative examples of basic physical laws.

On the theory that a man's intelligence practically reaches its ultimate growth by the age of eighteen, we are presenting to freshmen some topics previously taught to juniors and seniors—for example, the speed fluctuation of an engine and transients in electric circuits.

The course in the two freshman semesters includes mechanics and electricity. Since it has previously been described in some detail,<sup>1</sup> I shall merely com-

<sup>1</sup> Alan Hazeltine, *Journal of Engineering Education*, 30: 699, April, 1940.

ment on some salient features and on the results obtained.

All basic physical concepts and laws are derived from certain general observations, which are the axioms of physics. To express these observations, certain fundamental quantities (the mathematicians' undefined elements) are constructed, namely, distance, time, energy and electric quantity. And to formulate the consequences of these observations, many derived quantities are introduced, such as velocity, force, voltage, magnetic flux. In their quantitative aspect, these derived quantities usually enter as proportionality factors in special cases, and receive their general definitions as derivatives: velocity as the time derivative of distance, force as the distance derivative of energy, voltage as the derivative of energy with respect to electric quantity. A few derived quantities appear as integrals: momentum as the time integral of force and magnetic flux as the time integral of induced voltage. The student is taught to think first of a derivative as the slope of a graph and of an integral as the area under a graph; only in special cases are they directions to perform analytical operations.

The unconventional arrangement of giving electricity immediately after mechanics in the same course was chosen on account of the very close analogies: electrostatics is electrical elasticity and electromagnetism is electrical kinetics. This analogy is emphasized to increase the comprehension of both subjects.

The mechanics, especially elasticity and kinetics, forms the basis of the sophomore work in mechanical waves and sound; and the electricity forms the basis of the sophomore work in electrical fields and electric waves. Light then is introduced as an electric wave; and the laws of reflection and refraction are derived from those of dielectric and magnetic fluxes. (The sophomore work also includes heat, based on the Carnot cycle, and kinetic theory, electronics and an introduction to some of the more recent physical concepts.)

Our present physics course is more difficult for the student, is longer and results in lower average grades, than the course of a few years ago. Nevertheless, the response of the students is gratifying. Physics here is not an unpopular subject. There seems to be a trend in some places toward more superficial physics teaching, with the hope of making the physics course easier and hence more popular. As Professor Williams indicated, this is in the wrong direction: physics should be made more popular by being made more worth while. The late President Humphreys of Stevens often used to say: "Superficiality is the curse of American education."

ALAN HAZELTINE

STEVENS INSTITUTE OF TECHNOLOGY

## COLLECTION AND FILING OF ABSORPTION SPECTRA DATA

THE literature of absorption spectra is so widely scattered that frequently when a long search reveals that measurements have been made for a compound, the data are inconvenient to obtain. Too often no data at all can be located for compounds which have been known for a long time and which most certainly have been studied. The preparation of a new and complete but traditional atlas would offer no solution because it would be expensive to produce and, hence, limited in distribution, and because it would be rendered obsolete quickly by the publication of new data.

It is the purpose of this communication to suggest that a master card file of existing data be established at some central depository. Here the data and references for each substance or group of substances would be assembled in standard form, each upon a separate card. Once established such an index would be perpetually up to date if authors could be induced to supply their new data automatically and promptly. Photoprints or microfilm of the available data for any compound could then be furnished quickly at a small fee, and at moderate expense, institutions would be able to obtain more or less complete duplicate files. In this way it would be possible to avoid the expense of duplicating uninteresting and unnecessary information, thereby reducing the cost of the data actually wanted.

Compilation of the Absorption Spectra Card Atlas proposed above would facilitate and stimulate research and should deserve the support of some fund for scientific advancement. Once prepared the fees for supplying information should support the atlas.

ALFRED H. TAYLOR

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## THE OCCURRENCE OF FRESHWATER SPONGES IN THE HAWAIIAN ISLANDS

THE occurrence and distribution of freshwater sponges in Polynesia is still little known, due, perhaps, either to the lack of interest in or recognition of these interesting animals on the part of most collectors who are out for "bigger game."

Up to the present time the Fijian Islands seem to be the easternmost locality from which freshwater sponges have been recorded in Polynesia; for *Spongia gilsoni* Topsent<sup>1</sup> has been collected and described from these islands.

Mumford<sup>2</sup> and Adamson,<sup>3</sup> in very interesting articles dealing with the distribution of the terrestrial

<sup>1</sup> Emile Topsent, 5: 187-191, 1912.

<sup>2</sup> E. P. Mumford, *Ecology*, 17: 1, 143-157, 1936.

<sup>3</sup> A. M. Adamson, *B. P. Bishop Museum Bulletin* No. 159, pp. 1-98.

and freshwater faunas of the Marquesas Islands, do not mention freshwater sponges from this island group. Mumford cites Gee, who believes that they may occur here and will turn up eventually as a result of further collecting.

From my own experience in collecting in the Hawaiian Islands during the summer of 1935, I am convinced that freshwater sponges may occur in many of these Pacific Islands. Although Perkins's<sup>4</sup> excellent work on the fauna of the Hawaiian Islands does not mention the presence of these animals, yet during the latter part of July, 1935, I found freshwater sponges in a pool at the bottom of a waterfall at Haepuaena on the Island of Maui. These sponges, vividly green in color and very apparent in the clear water of the pool, were found in large masses encrusting the undersides of rocks and submerged pieces of wood. A request for information concerning the distribution and occurrence of freshwater sponges in Hawaii was made to Dr. E. H. Bryan, Jr., curator of collections of the B. P. Bishop Museum in Honolulu, with the resulting information that Dr. Otto Degener of Honolulu had upon several occasions collected these animals in various parts of the Hawaiian Islands. A request to examine these specimens failed to elicit them, since they apparently had been lost. However, Dr. Degener very kindly sent me specimens which he had collected during the month of February, 1936, on the Island of Oahu. An examination of these two specimens reveal them to be *Heteromyenia baileyi*. Thus as a result of these collections the occurrence of freshwater sponges in the Hawaiian Islands is established for the first time, and the known distribution of these sponges in Polynesia is greatly extended both to the north and east.

ARTHUR SVIHLA

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### EARLIEST LAND VERTEBRATES OF THIS CONTINENT

ALTHOUGH discovery of amphibian remains in Greenland in deposits close to the Devonian-Carboniferous boundary<sup>1</sup> makes it certain that the origin of

land vertebrates occurred in the Devonian Period, we know little of their history until a much later date. In American terminology the Carboniferous is customarily divided into two periods, the Mississippian (lower) and Pennsylvanian (upper). In the Coal Measures of the latter part of the Pennsylvanian, amphibians already well advanced and specialized are numerous and fairly adequately known. But for the entire stretch of time between the beginning of the Carboniferous and the Coal Measures, a period of perhaps 50 to 75 millions of years, land vertebrates, save for footprints, are almost unknown. In Scotland a dozen or so specimens have been found in late Mississippian deposits.<sup>2</sup> Not a single bone has been reported from Carboniferous rocks below the Coal Measures in any other area of the globe.

Last winter the presence of vertebrate remains in the Carboniferous shales of the Hinton District of West Virginia was reported to us by Mr. Harry Damron, graduate student at Harvard University; this locality has been investigated, under his guidance, by R. V. Witter and the writer. In addition to fishes the deposit contained numerous remains of amphibians. Unfortunately the bones are disarticulated and often fragmentary, so that their morphological value is limited. Stratigraphically, however, they are of great interest. Amphibians had been found in various instances in relatively late deposits in the Appalachian coal field area, and we had assumed that the present locality would also prove to be Pennsylvanian in age. To our surprise and delight it proved to be much earlier. The horizon is that of the Hinton shales of the Mauch Chunk Group. These amphibians are thus Mississippian in age. They are exceeded in antiquity only by the Greenland skulls mentioned above, and equalled only by the Scottish materials; they are by far the oldest skeletal remains of tetrapods in continental North America. Despite their incomplete nature these bones are thus important documents in the deciphering of the early history of land life.

ALFRED S. ROMER

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## QUOTATIONS

### SOIL FERTILITY

A SPIRITED correspondence has followed Lord Cranworth's warning that soil fertility may become exhausted by the pace of the war-time food production campaign, and has brought out several points which

<sup>4</sup> R. C. L. Perkins, "Fauna Hawaiiensis," Introduction, 1913.

<sup>1</sup> Sève-Söderberg, G. Meddelelser om Grønland, Bd. 94, Nr. 7, 105 pp., 1932.

have vital significance for the nation as well as for farmers. Larger quantities than ever before of fertilizers, such as superphosphate and sulphate of ammonia, have been applied to the land in the past year, and as a result heavier crops have been grown. It has been the deliberate policy of the government to secure increased supplies of fertilizers and to see that

<sup>2</sup> These have been reviewed by D. M. S. Watson, Palaeont. Hungarica, I, 221-252, 1926.

they are applied to the land. In many cases farmers who until now have made little use of fertilizers were ordered by the War Agricultural Committees to give their corn a dressing this spring, and there is no question that this provision of extra supplies of available plant food in the top soil has given the country bigger crops than could otherwise have been expected.

It is true that this has been an exceptional growing season, and that the growth of some crops was so lush that the straw did not stand battering by wind and rain and patches of corn are now lying flat. Even so, on balance the nation will gain extra crops. In a few of the worst cases the promise of extra grain has been lost and the farmer is faced with a heavy task in saving what he can. That is part of the gamble that is inherent in farming in an uncertain climate. Last harvest there was no such trouble, however generously chemical fertilizers had been applied. This year the trouble is not confined to fields where sulphate of ammonia was used. Some of the laid corn is to be found on land newly ploughed out of old grass rich in plant food. The lesson to be learned is surely that chemical fertilizers used prudently can greatly increase the yield of crops—especially if the farmer knows enough about his business to grow the stiffer strawed varieties of corn that will stand to harvest on well-fed land even in an exuberant season like this.

Everywhere farmers with long experience of arable farming will vouch for the value of chemical fertilizers when used properly as a supplement to the organic matter in the soil which provides the reservoir of the plant foods on which the crops draw year after year.

In our settled type of farming livestock have long played a dominant part, and, despite the reduction in numbers of pigs and the grass flocks of sheep, they continue to do so to-day. The encouragement lately given to hurdled flocks should bring more sheep on to the lighter arable lands where they can be most valuable in maintaining fertility. Unless the balance of our farming is seriously upset—and there is little prospect of that—there is no risk of soil exhaustion and erosion, such as occurs in the New World, where wheat is grown by the square mile and then the land abandoned while fresh areas are tapped. In this green island we are now ploughing and cropping 4,000,000 more acres than we did two years ago, and dormant fertility lying under the grass sod is being stirred to produce the extra cereals, potatoes, and other crops that the nation needs in war-time. Other fields which have grown a succession of corn crops are being under-sown with clover and grass to grow a productive sward for long enough to allow the store of organic matter to be replenished. There is really no special virtue in dormant fertility.

Moreover, if agriculture is to regain its full place in the nation's life, the soil itself must be alive and fully productive. The tenets of good husbandry are so well understood in this country that the general public need have little fear that the land will suffer if farmers are allowed to use their discretion in developing production. On the contrary, the new life that is stirring in agricultural Britain is one of the few benefits arising from the present conflict that must be allowed to persist in the years after the war.—*The Times, London.*

## SCIENTIFIC BOOKS

### QUALITATIVE ANALYSIS

*Elementary Qualitative Analysis* By J. H. REEDY.  
Third edition. x+156 pp. New York: McGraw-Hill Book Company. 1941. \$1.50.

THERE is a growing trend in colleges to teach qualitative analysis by semi-micro techniques. The obvious advantages are the substitution of centrifuging for filtration and a saving in time and material. This latest edition of Professor Reedy's text adds another to the list of books in which these techniques are used. In the present instance, however, the change is not complete since macro procedures are retained for a few of the analytical steps.

This text is presumably designed for a one-semester course for sophomore students in chemistry. In contrast to the more usual text in this field in which sections on theory, description and analysis are to be found, this book contains only the analysis material.

Consequently its use will probably involve a companion text covering the other two parts of the subject.

There are two main parts to the book, a section on cation analysis and another on anion analysis. There is also a brief section on the systematic analysis of various solid substances. In addition to detailed and probably quite satisfactory directions for analysis, the two main sections contain well-organized sets of preliminary experiments and groups of study questions for each of the several groups of ions considered. The cation analysis material takes up the usual restricted list of ions and employs standard methods of separation. There are, however, new procedures for the Tin Sub-Group and for the Alkali Group. The anion analysis section considers an unusually large number of anions. The method of analysis is the now common combination of group eliminations and subsequent specific tests.

The book is well made and printed and typographical errors are infrequent. It does contain a few expressions that depart from common chemical usage. Examples are "complexing" for "complex ion forming" and "alkalize" for "make basic." The definition of a buffer as "a salt that will neutralize a solution" is decidedly unorthodox. For the most part ionic equations are given for reactions in which strong electrolytes are involved, but unfortunately this is not done consistently. Some of the explanations given in the otherwise admirable notes are not in accord with prevalent concepts of inorganic and physical chemistry.

Among the desirable features of this book are the well-organized preliminary experiments and directions for analysis and the adherence to more easily understood organic tests. Some teachers will find less desirable the inconsistent treatment of ionic reactions, the paucity of explanations based on quantitative equilibrium data and the occasional inclusion of explanations of doubtful accuracy.

F. A. LONG

*Semi-Micro Qualitative Analysis.* By CARL J. ENGELDER, Ph.D., professor of analytical chemistry, University of Pittsburgh; TOBIAS H. DUNKELBERGER, Ph.D., assistant professor of chemistry in the Graduate School, Duquesne University; and WILLIAM J. SCHILLER, Ph.D., head, Chemistry Department, Mount Mercy College. Second edition. xii + 305 pp. 15.5 × 23 cm. New York: John Wiley and Sons, Inc. 1940. \$2.75.

THE first edition of this book appeared in 1936 and introduced the semi-micro technique in qualitative inorganic analysis, which was readily adopted by many laboratories. The new and enlarged edition will be welcomed by all those interested in qualitative analysis. The theoretical section has been rearranged and modernized. Sets of questions and problems have been inserted at frequent intervals throughout the book, and a new scheme for anion analysis has been added. Many supplementary tests given in the first edition have been omitted. More than 200 references to the original literature are listed in the sections on cation and anion analysis.

JOHN H. YOE

*An Introduction to Quantitative Chemical Analysis.*

By WARREN C. VOSBURGH, professor of chemistry, Duke University. viii + 356 pp. 18 tables, 27 figures. New York: Henry Holt and Company. \$2.75.

THE preface states, "This book is designed as a textbook for a quantitative analysis course of about one semester's length in which theory and practice are given about equal weight." Although there are inter-

esting features in the book, it does not rank with leaders in the field.

There are twenty-five chapters covering the usual theoretical and practical aspects of quantitative analysis. Interspersed in this material are twenty-seven exercises which may form the laboratory work of an introductory course. This arrangement of material necessarily causes some duplication and waste of space. In the early part of the book, some topics are perhaps handled in too elementary a manner. The first three chapters contain conventional material regarding apparatus, the use of the balance and calibration of weights. Beginning with chapter four, subject-matter is arranged so that gravimetric analysis is treated first and volumetric methods second. Two chapters on the theory of precipitation cover solubility product and formation of precipitates. Volumetric analysis is presented in the following order: nomenclature and calculations, apparatus and calibration, acidimetry and alkalimetry, hydrogen ion concentration, theory of titration, titrations involving precipitation, oxidation and reduction theory and practice, potassium permanganate, ceric sulfate and iodometry, oxidation potentials. For the most part, this conforms to the older arrangement of a course in quantitative analysis and has several advantages. There will be differences of opinion regarding the manner in which subject-matter has been handled. One or two illustrations will suffice. This reviewer believes that the presentation of "the titration of weak acids," "buffers" is inadequate. A fault is shared with other texts in that very little space is devoted to the discussion of water and to the preparation of samples in spite of the fact that the analysis is no better than the selection and preparation of the samples. Alternative parts of procedures are placed in the body of some of the exercises, a confusing method. It is believed that alternative sections should come at the end of the procedure or be placed in the footnotes. A final illustration concerns the choice of procedures and the order of presentation. Particularly in that section of the book which deals with gravimetric analysis, one gains the impression that the exercises are separate, independent procedures, unrelated to one another. The ideal course should be developed so that starting with simple principles and gradually adding more complex ones, a fundamentally sound, although elemental, picture of quantitative analysis is produced at the end of the semester. This text falls short of this goal. Gravimetric iron, phosphorus and magnesium are presented as independent, almost unrelated, procedures, and limestone or natural rock are barely mentioned. Thus a rare opportunity is missed to present an important relationship between qualitative and quantitative analysis and to determine more than one element in one sample. Adequate presentation of solution of

natural samples is also omitted. There are some good sections in the book. The use of definite exercises facilitates the organization of a course. In general, the reaction of the reviewer toward this text is unenthusiastic.

VILLIERS W. MELOCHE

*Ionic Equilibrium as Applied to Qualitative Analysis.*

By T. R. HOGNESS and WARREN C. JOHNSON, both at the University of Chicago. x + 306 pp., with 18 tables and 23 illustrations. New York: Henry Holt and Company. 1941. \$2.00.

ACCORDING to the preface this book "consists of the revised edition of the complete text, 'Qualitative

Analysis and Chemical Equilibrium.' It is designed to meet the needs of teachers who either prefer to use their own particular scheme of analytical procedure or want to include in their course supplementary material on chemical equilibrium in the form of problems and exercises."

Separate publication of Part I with minor additions and improvements over the 1937 edition should make this well-known exposition more attractive as a basis for class work. While the Brønsted theory is now included the authors still rightly maintain that its consistent and exclusive use is not advisable—*Cf. Jour. Chem. Education*, 14: 448, 1937.

BYRON A. SOULE

## SPECIAL ARTICLES

### TYPICAL URINARY CRYSTALS OF THREE SULFANILAMIDE DERIVATIVES PRODUCED IN VITRO<sup>1</sup>

FOLLOWING the administration of sulfapyridine, sulfathiazole or sulfadiazine to humans, corresponding crystals with characteristic shapes may appear in the urine (Fig. 1). These crystals were found to consist for the most part of the acetylated derivatives of the aforementioned compounds. Their appearance, however, is entirely different from the simple rectangular, rhomboid or trapezoid structures which can be obtained by crystallizing the pure acetyl derivatives from water.<sup>1a</sup> It seemed of interest, therefore, to investigate the influence of urine upon the crystal shape of acetylated sulfanilamide compounds.

Crystallization of the pure acetyl derivatives of sulfapyridine, sulfathiazole and sulfadiazine from normal human urine gave crystals identical with the simple forms obtained from water. This result remained uninfluenced by the addition of the free compounds to the urine. The presence of sugar and albumin in the specimen likewise had no effect upon the crystal forms. If, however, the urine of patients, receiving one of the above-named sulfanilamide derivatives, was used for crystallization of the acetyl compounds, the forms obtained in a large majority of experiments were identical with urinary crystals (Fig. 1), occurring naturally in such urines. The *in vitro* formation of these urinary crystals was not dependent upon the original presence of such forms in the patient's urine. The faculty of producing typical urinary crystals of sulfanilamide derivatives, ap-

parently occurring exclusively in urines of patients receiving the compounds, suggests the presence of a certain substance in these urines responsible for the effect. Experiments on the nature of the crystal-forming reaction are in progress.

The structures of urinary crystals outlined in Fig. 1 are those most commonly encountered. They are

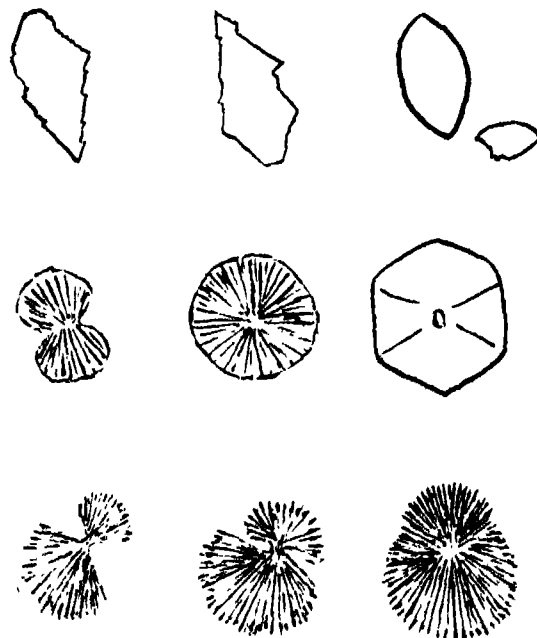


FIG. 1. Crystals appearing in human urine after administration of (top to bottom): *Sulfapyridine*—arrowheads and whetstones. *Sulfathiazole*—Striated dumb-bells (shocks of wheat with central binding), rosettes with radial striations and regular hexagonal platelets (all structures *symmetrical*). *Sulfadiazine*—Striated dumb-bells (shocks of wheat with excentric binding) and shell-forms with radial striations (all structures *asymmetrical*). It is apparent that the sulfathiazole rosettes and the sulfadiazine shells grow out of their respective dumb-bell forms. (Traced from micro-photographs of urinary sediment, enlargement 250 ×)

<sup>1</sup> Aided by a grant from the Sidney C. Keller Research Fund.

<sup>1a</sup> A saturated aqueous solution of any of these urinary crystals contained the acetyl derivative of the respective drug in a concentration which very significantly exceeded the solubility in water of the chemically pure acetylated compound. It was usually about twice as high.

based upon a follow-up study of crystal shapes in urines of 87 patients treated with sulfapyridine, sulfathiazole and sulfadiazine. Though varying in form from individual cases and sometimes even from the same patient on consecutive days, they were found to present forms specific for each of the three compounds investigated. Detailed data on physical and chemical analysis of these crystals will be published elsewhere. (Microphotographs of urinary crystals showing some of the typical sulfapyridine, sulfathiazole and sulfadiazine forms have been presented in several publications.<sup>2, 3, 4, 5</sup>)

Crystallization experiments have been carried out with the urines of 51 patients receiving sulfapyridine, sulfathiazole and lately also sulfadiazine. In all specimens investigated, the *in vitro* formation of urinary crystals was attempted with acetylsulfapyridine as well as acetylsulfathiazole, regardless of which of the three compounds had been given to the patient. In recent experiments acetylsulfadiazine also was used.

For crystallization, an excess of the compound is added to the filtered and acidified urine, heated to boiling and immediately filtered. Crystals appear in the filtrate as it cools to room temperature.

It was found that urines of patients receiving sulfathiazole or sulfadiazine usually gave typical urinary crystals with both acetylsulfathiazole and acetylsulfadiazine, while with acetylsulfapyridine the forms obtained from these urines were atypical, although mostly different from crystals of the pure compound in water. Sulfapyridine urines, on the other hand, produced characteristic whetstones or arrowheads with acetylsulfapyridine, whereas the crystals formed with the acetyl products of sulfathiazole and sulfadiazine deviated more or less from their described typical appearance. In some instances sulfapyridine urines produced characteristic urinary crystals with the acetylated compounds of all 3 sulfanilamide derivatives.

Of the 51 urine specimens investigated, in 32 characteristic urinary crystals could be produced with at least one of the 3 compounds. The most typical form was always obtained with the acetyl-derivative of the drug which the patient had received. The shapes produced were identical with those shown in Fig. 1. Sixteen of the urines yielded more or less atypical crystals, while 3 gave negative results (forms as from water). These 3 urines had specific gravities

between 1.010 and 1.014. In general it was observed that the production of characteristic urinary crystals may not succeed with highly diluted urines; it can, however, often be achieved with such specimens by concentrating them on the steam-bath before use for crystallization. On the other hand, urines can be depleted of their faculty to form urinary crystals by repeated supersaturation with an acetylated compound and removal of the crystals which appear on cooling. An alkaline reaction will inhibit the production of urinary crystals. The crystal-forming potency can be restored upon acidification. If urinary crystals are recrystallized from normal urine or water they assume the simple shapes which are obtained from water with the pure acetylated compounds. Urines of patients receiving sulfanilamide do not seem to possess the faculty of forming urinary crystals with the 3 compounds studied.

The artificial production of urinary crystals proves that the shapes outlined are specific for the individual compounds and are formed from their acetylated derivatives. The presence of such crystals in the urine, therefore, makes it possible to identify the particular sulfanilamide compound administered to the patient.

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#### A FILTERABLE VIRUS DEMONSTRATED TO BE THE INFECTIVE AGENT IN OVINE BALANO-POSTHITIS<sup>1</sup>

SO-CALLED venereal infection of sheep has been recognized in some sheep-raising areas of the United States and other countries for over thirty years. It is known in this country as foul sheath, sheath infection, balanitis, venereal form of lip and leg ulceration and, in Australia, it is called pizzle-rot. Filmer, in Australia, proposed the terms posthitis and balanoposthitis. Lesions are most commonly found at the prepuce orifice and on the lips of the vulva, and in the male the penis may be involved. The disease is characterized by ulceration with scab production. The more severe lesions have been noted on the prepuce and vulva. Severe sheath lesions usually result in phimosis or paraphimosis. The penis lesion is ordinarily a mild inflammation with ulceration unless accompanied by paraphimosis, which then results in a severe process with the more extensive ulceration and heavy scab formation such as is found on the prepuce.

Until late years, the disease has been classified as one of the many necrophorus infections. In a previous examination of two naturally infected rams

<sup>1</sup> Paper No. 155, Journal Series, Agricultural Experiment Station, Montana State College.

<sup>2</sup> W. Antopol, *Jour. Urolog.*, 43: 589, 1940.

<sup>3</sup> J. E. Sadusk, Jr., F. G. Blake and A. Seymour, *Yale Jour. Biol. and Med.*, 12: 681, 1940.

<sup>4</sup> F. W. Sunderman and D. S. Pepper, *Am. Jour. Med. Sci.*, 200: 790, 1940.

<sup>5</sup> D. Lehr and W. Antopol, *Urol. and Cutan. Rev.*, 45: 545, 1941.

presented at this laboratory, no necrophorus organisms could be found. In November, 1940, a number of ewes and rams affected with the venereal infection were made available for study. The ewes had ulcerative vulvitis and the rams had prepuce and penis lesions. In the majority of cases, the lesions were newly developed, presenting ideal material for bacteriological and virus examinations.

Aerobic and anaerobic cultures were made from the lesions of five naturally infected sheep, and six others that had been experimentally infected. Of this group of vulva, sheath and penis lesions, only the young or freshly formed ulcers were cultured. No anaerobes were recovered and none of the aerobic types were consistently present in all the lesions, with the exception of a very small Gram-negative bacillus. This organism was not pathogenic for guinea pigs or rabbits when injected intraperitoneally, and there was no evidence of an infection where pure cultures were swabbed into the scarified tissue of the vulva, prepuce or penis of experimental sheep.

Although experimental transmission of the disease was easily accomplished through the use of suspensions of the diseased tissue, a number of failures were experienced before an infective, bacteria-free filtrate was prepared. The technic by which the infective filtrates were obtained was as follows: The diseased tissue was finely ground with alundum, and then a suspension was prepared, using equal parts of beef broth (pH 8.2) and distilled water to which 5 per cent. horse serum was added. The suspension was clarified by high-speed centrifugation and the supernatant liquid was filtered. Successful filtrations were made with two virus suspensions of separate origin. The hydrogen ion concentration of the suspensions before filtration was pH 7.0 in one case and in another pH 8.2. Three infective filtrates were recovered from one suspension after passage through Berkefeld N & W candles and a 7 pound Mandler candle. The other suspension was filtered through a  $3\frac{1}{2}$  per cent. collodion membrane. Subcultures from these filtrates remained free of bacterial growth.

Typical lesions were produced on the prepuces of experimentally inoculated rams with each of these four filtrates. The disease was again transmitted to healthy experimental rams by prepuce inoculations with virus suspensions from two of the filtrate-produced cases. The experimental animals used in the tests and the premises on which the tests were conducted were free from infection before inoculation, as proven by uninoculated rams that were held as controls.

E. A. TUNNICLIFF  
PETER H. MATISHECK

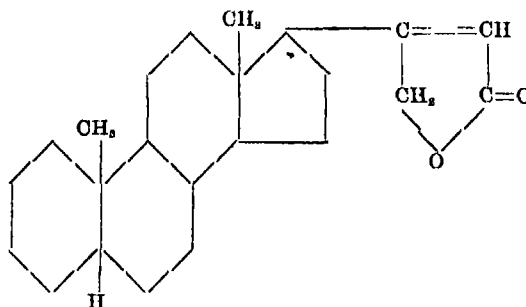
MONTANA VETERINARY RESEARCH LABORATORY

## SYNTHESES OF MODEL UNSATURATED LACTONES RELATED TO THE CARDIAC AGLYCONES

SYNTHESES of  $\beta$ -substituted  $\Delta^4, \beta$ -unsaturated  $\gamma$ -lactones related to the cardiac aglycones have been reported from different laboratories.<sup>1,2</sup> The substances described thus far represent with a high degree of certainty the lactone portion of the natural aglycones, having simple aliphatic, alicyclic and aromatic groups substituted for the cyclopentanophenanthrene part. Such compounds are not without value, and help to interpret reactions of the natural aglycones, which were difficult to explain previously. It was felt, however, that substances bearing a closer resemblance to those occurring in nature would be of interest for further study.

Of the syntheses published, that employing a carboxylic acid as starting material<sup>3</sup> appears to be particularly suited for the purpose in mind. From any etio acid, prepared by a Barbier-Wieland degradation of the corresponding bile acid, one proceeds to the desired lactone through the 21-acetoxy-methyl ketone, meanwhile protecting any alcoholic groups present. A similar series of reactions has recently been published by Ruzicka, Reichstein and Fuerst,<sup>4</sup> who converted 3,21-diacetoxy- $\Delta^4, \beta$ -pregnenone-(20) into the lactone of 3,21-dihydroxy- $\Delta^4, \beta$ -20,22-norcholadienic acid.

We wish to report the synthesis of the lactone of 21-hydroxy- $\Delta^{20,22}$ -norcholenic acid<sup>1</sup> in this brief note, leaving a detailed discussion for a later communication. This lactone, like digitoxigenin, thevetin and others, shows a *cis*-relationship of rings A and B as well as identical relative positions of the unsaturated lactone ring and the methyl group at C 13<sup>5</sup>. Etiocholenic acid through its acid chloride was converted into 21-diazo-pregnanone-(20), which with dry HCl in ether yielded 21-chloro-pregnanone-(20). This was reacted with sodium benzoate in 90 per cent. alcohol to give 21-benzoxy-pregnanone-(20), and the



<sup>1</sup> Elderfield, *et al.*, *Jour. Org. Chem.*, 6: 260, 1941.

<sup>2</sup> Ranganathan, *Current Sci.*, 9: 458, 1940.

<sup>3</sup> Linville and Elderfield, *Jour. Org. Chem.*, 6: 270, 1941.

<sup>4</sup> Ruzicka, Reichstein and Fuerst, *Helv.*, 24: 76, 1941.

<sup>5</sup> Jacobs and Elderfield, *Jour. Biol. Chem.*, 108: 497, 1935.

latter subjected to a Reformatsky reaction with zinc and ethyl bromo-acetate, thus effecting condensation, partial dehydration and lactonization simultaneously. The lactone<sup>1</sup> melts at 167–168° (corr.) and reacts positively towards Legal's and Tollens' reagents. It shows the following analytical figures: Calculated for  $C_{24}H_{34}O_2$ : C, 80.6; H, 10.0. Found: C, 80.4; H, 10.1.

A detailed description of this and other lactones will appear in *The Journal of Organic Chemistry*.

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## SCIENTIFIC APPARATUS AND LABORATORY METHODS

### THE MAGNETIC PROPERTIES OF CATALASE

RECENTLY a modification of Gouy's method of measuring magnetic susceptibilities has been elaborated in this laboratory primarily for the quantitative determination of free radicals of organic dyestuffs during the process of reduction. The result is an increased sensitivity over existing methods. The method will be described in a paper now in press and may be outlined very briefly as follows.

A long cylindrical vessel with a septum in the middle, dividing it into an upper and a lower compartment, quite similar to one first used by Freed and Casper,<sup>1</sup> and later especially by Pauling and Coryell,<sup>2</sup> is suspended between the pole pieces of an electromagnet. The upper end of the suspending wire is attached to the one pan of a semi-micro balance, which is magnetically damped, very nearly critically. The pointer of the balance is equipped with a scale of 200 divisions readable through a microscope, each line corresponding to about one hundredth of a milligram. The upper compartment of the vessel is filled with a solution, or suspension, of the substance to be measured. The lower compartment is filled with the pure solvent. After switching on the magnetizing current only the maximum deflection on the microscope scale is observed, which is reached in 15 seconds. The significance of each line of deflection is previously calibrated in terms of change in magnetic susceptibility. Repeated readings allow an accuracy, according to conditions, within one or a few per cent., even when the experiment is based on a magnetic pull of, say, one fifth of a milligram. This method has been used for the measurement of the susceptibility of crystallized catalase,<sup>3</sup> suspended in a dilute phosphate buffer. Thus far the measurements have been made under conditions not especially favorable for weighing, i.e., warm and humid summer weather, and they may be worth repeating later on under better conditions. Even so, results could be obtained which were scarcely accessible to the method of direct weighing as used by Pauling and Coryell. Since catalase has four times

the molecular weight of hemoglobin, yet not more iron in one molecule than the latter, and the concentration at which a suspension—not to speak of a solution—can be obtained, is limited, the increase in sensitivity over previous methods was essential for these experiments. The result obtained so far is that the magnetic moment of catalase, per gram-atom iron, is 4.64 Bohr magnetons. The probable error, under the unfavorable conditions mentioned, is estimated to be  $\pm 0.3$ . This value would be close to 4.47 as obtained by Coryell and Pauling for ferri-hemoglobin hydroxide (alkaline methemoglobin), and smaller than for ferro-hemoglobin (5.46) or ferri-hemoglobin (5.8). The magnetic experiments on catalase are being continued.

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### GLASS ELECTRODE FOR DETERMINATION OF HYDROGEN ION ACTIVITY OF SMALL QUANTITIES OF CULTURE MEDIA

INVESTIGATIONS of changes in pH in controlled cultures necessitate means of determining the pH of relatively small quantities of fluid. It was felt that a system whereby three determinations of pH could be made from as little as 1 ml of fluid would be very advantageous. After reviewing the possibilities of several micro vessels for this work, it was decided that a relatively large durable or condenser type of glass electrode, as described by MacInnes and Belcher,<sup>1,2</sup> could be used, provided it was modified in some respects and a method developed for using the modified instrument. The results have been extremely satisfactory. The instrument is very stable and rugged. It is easily cleaned without being dismantled. Furthermore, the method of sampling and determination of pH precludes errors which might arise from addition or loss of gases such as  $CO_2$ .

A glass electrode is made (Fig. 1) with the following limitations and modifications:—The Corning No.

<sup>1</sup> S. Freed and C. Casper, *Physical Rev.*, 36: 1002, 1930.

<sup>2</sup> L. Pauling and C. Coryell, *Proc. Nat. Acad. Sci.*, 22: 159 and 210, 1936.

<sup>3</sup> J. B. Sumner and A. L. Dounce, *Jour. Biol. Chem.*, 125: 33, 1938; 127: 439, 1939.

<sup>1</sup> D. A. MacInnes and D. Belcher, *Industrial and Engineering Chemistry, Analytical Edition*, 5: 199, 1933.

<sup>2</sup> D. A. MacInnes and L. G. Longworth, *Transactions of the Electrochemical Society*, 71: 73, 1937.

.015 glass capillary of the glass electrode should be of a length and inside bore to hold approximately 0.3 ml of fluid. The electrodes which we made averaged about four inches in length. The jacket of the electrode is extended to form a funnel 20 mm high and 25 mm across the top. The space at the bottom of the funnel is ground to accommodate a standard ground tip of a 1.0 ml hypodermic syringe. The hypodermic syringe is of the insulin type—long with a solid plunger, modified as follows: a 1 millimeter hole is drilled through the wall of the syringe, 2 mm above the last graduation and a short groove 2 mm long is cut in the lower end of the solid plunger.

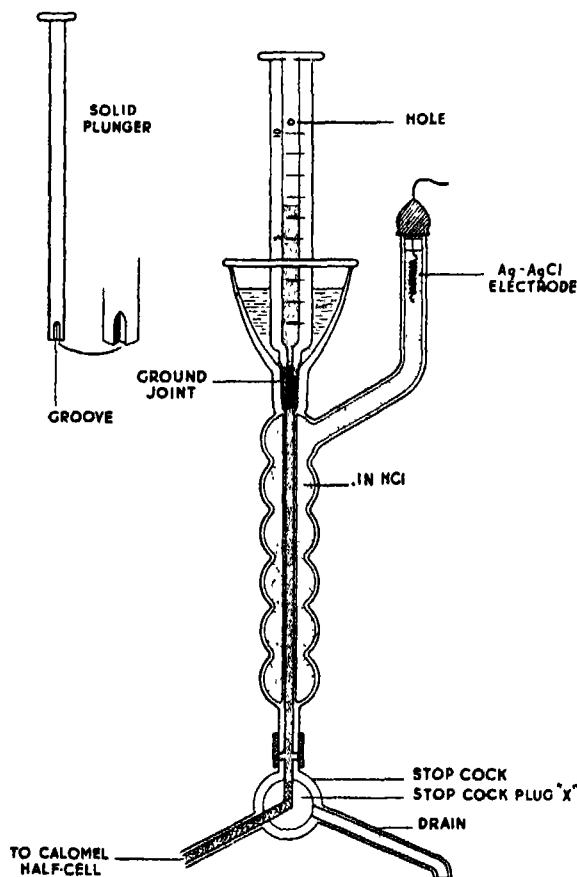


FIG. 1

## METHOD OF OPERATION

The glass electrode is set up in an electrically shielded copper box connected by shielded cables to a type #7660 Leeds and Northrup Company pH indicator. After the glass electrode has been calibrated for acetate buffer pH 4.64 it is thoroughly washed out with distilled water. The stop-cock (Fig. 1, X) is then closed so that the distilled water fills the electrode and extends halfway up the funnel.

The material to be studied is introduced into the

hypodermic syringe, care being taken to see that the groove in the solid plunger is oriented 180° from the hole in the syringe wall. In the case of pure cultures of protozoa the material is secured through a sterile needle introduced into a vaccine port blown in the side of the culture flask.<sup>3</sup> The needle is removed from the syringe and the syringe tip is introduced through the distilled water in the funnel and seated in the ground joint at the upper end of the glass electrode. This effectively seals off the distilled water in the funnel and places the culture medium in the syringe in direct contact with the column of distilled water in the glass electrode, without the possibility of any air bubbles being formed in the system. The plunger of the hypodermic syringe is now turned 180 degrees until the slot and the hole in the syringe coincide. The plunger may now be withdrawn without exerting pressure on the fluid. By carefully opening the stop-cock (Fig. 1, X) 0.3 ml of the culture medium is allowed to displace the distilled water in the electrode. The amount is determined by following the meniscus on the graduations of the syringe. The stop-cock (Fig. 1, X) is now turned to make a liquid junction and a determination is made. Two more determinations are made with the remaining available fluid. The syringe is then removed and the electrode again thoroughly washed with distilled water.

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<sup>3</sup> G. W. Kidder, *Physiological Zoology*, 14: 209, 1941.

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## THE PACIFIC OCEAN<sup>1</sup>

By Dr. H. U. SVERDRUP

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THE Pacific Ocean can be discussed from a number of different points of view. One could deal with the history of its discovery and exploration from the time of Magellan's long and perilous journey up to the present day when clippers of the air cross and recross the ocean in a few days, or one could discuss its importance as a highway of the sea carrying trade between large surrounding countries, or one might consider it as determining the routes for the migration of man and the spreading of culture from island group to island group and from continent to continent. I shall not attempt to discuss the Pacific Ocean from any of these points of view, but shall, instead, deal with the water masses themselves and with the

systems of prevailing currents, and shall indicate how the ocean influences the climate and the weather of the surrounding land and how the productivity of the sea, which is becoming increasingly important to the economy of man, varies from one region to another because of the character of the currents.

As a starting point let us examine the distribution of surface temperature over the Pacific Ocean in the month of August. The striking features are, in the first place, the vast extent of the tropical areas in which the surface temperature is very high, above 24° C. (75° F.), and, in the second place, the tongues of low temperature which extend towards the Equator along the western boundaries of the ocean, that is, along the coasts of North and South America. Due to the intrusion towards the Equator of these cold

<sup>1</sup> Contributions from the Scripps Institution of Oceanography, New Series, No. 147.

waters the width of the tropical region is much smaller on the American side than on the Asiatic-Australian side. This contrast between west and east is closely related to the character of the currents, and we shall later on return to this relationship. The point which will be emphasized now is that the surface waters of the Pacific Ocean are very warm over large areas in the tropics, moderately warm over smaller areas in middle latitudes, and cold only in high northerly and high southerly regions.

Observations of the temperature at subsurface levels show, however, that only a relatively thin surface layer is heated and that the enormous water masses which fill all the deep basins of the Pacific Ocean are cold, having a temperature which lies less than  $2^{\circ}$  C. above freezing. Thus, to the south of the Aleutian Islands the very surface waters in summer are moderately warm, but below a depth of 60 meters the temperature varies between  $3^{\circ}$  and  $1.6^{\circ}$  only. In the trade-wind region in the North Pacific high surface temperatures are encountered, but below a thin top layer the temperature decreases rapidly with depth and below 1,500 meters again remains below  $3^{\circ}$ . In the region of the trade-winds of the Southern Hemisphere a similar temperature distribution is found. In  $50^{\circ}$  S near the center line of the South Pacific, the temperature is above  $5^{\circ}$  down to a depth of 900 meters, but below 1,500 meters is nearly the same as that observed in the other localities.

Below a depth of 2,000 meters the salinity of the Pacific waters is nearly constant, the salt content varying only between 34.6 and 34.7 parts per thousand (per mille), that is, only by about 0.1 gram in one kilogram of water.

The deep water of the Pacific is of greater density than the waters near the surface, and in the Pacific as well as in all other oceans we find the water masses arranged in stable stratification, that is, we always find the denser waters near the bottom and the lighter water masses at the surface. Now, the density of the ocean waters is changed only when the water is in contact with the atmosphere where it may be heated or cooled or where the salinity may be increased or decreased by evaporation or precipitation. In general, we therefore find certain regions where the surface waters attain a great density, and from where they sink to the level at which the density attained at the surface prevails. These are regions in which the subsurface water masses are formed. The formation of the uniform deep water of the Pacific was, however, for a long time puzzling to oceanographers because no region in the Pacific Ocean could be found in which such water was formed at the surface and sank towards the bottom. Over wide areas in the north-western North Pacific the temperature is in winter as

low or lower than the temperature of the deep water but the salinity remains so low that the water is much lighter than the deep water and can not sink towards the bottom. Similarly, in the Antarctic part of the South Pacific no sinking of cooled surface water takes place. The puzzle was solved when it was realized that the deep water of the Pacific is not formed in that ocean but originates mainly from the Atlantic Ocean, where sinking of surface water takes place both in high northerly and high southerly latitudes.

In the Atlantic Ocean deep water of high salinity ( $34.9^{\circ}/_{\text{oo}}$ ) and relatively high temperature ( $2.5^{\circ}$  C.) is formed to the north where the high salinity water of the Gulf Stream is cooled in winter and attains such a high density that it sinks to great depths. The salinity of the North Atlantic deep water over large areas is increased by addition of high salinity water flowing out from the Mediterranean. In the Antarctic region to the south of the Atlantic the density of the water is increased by cooling and freezing of ice, leading to the formation of a bottom water of low temperature ( $-0.6^{\circ}$  C.) and moderate salinity ( $34.6^{\circ}/_{\text{oo}}$ ). These two types of deep water spread south and north, respectively, and the spreading can be recognized in vertical sections showing tongue-like isotherms and isohalines. Mixing takes place and, due to this, a fairly uniform body of water is formed to the north of the Antarctic Continent within the region of the circumpolar Antarctic Current which circles the Antarctic Continent as the greatest current of all oceans. Within the greater part of this body the temperature varies only between  $2.5^{\circ}$  and  $0^{\circ}$ , and the salinity between  $34.65^{\circ}/_{\text{oo}}$  and  $34.75^{\circ}/_{\text{oo}}$ . In the Atlantic and Indian sectors the influence of the warm and saline deep water of the northern seas and the cold and less saline bottom water of the Antarctic is evident, but otherwise the striking feature is presented by the very small differences in temperature and salinity within the entire region. The water is particularly uniform in the Pacific sector and it is this uniform circumpolar water which spreads north and fills the entire basins of the Pacific, being slightly diluted by low salinity water from higher levels. In the South Pacific a vertical circulation provides for exchange of water with the Antarctic circumpolar water mass, but in the North Pacific such circulation is lacking. There the small inflow of deep water from the south appears to be compensated by an outflow to the Indian Ocean between the islands of the East Indian Archipelago.

A vertical section showing the distribution of temperature and salinity in the Pacific Ocean clearly demonstrates the point that on the whole the waters of the Pacific are very cold and that only a relatively thin surface layer is heated. Between the deep water and the warm surface layers intermediate water

masses of low salinity are present. These are formed partly in the Antarctic and partly in the Arctic regions of the Pacific Ocean and have their counterparts in the Atlantic.

Let us now return to conditions near the surface of the ocean in order to examine how the general distribution of temperature in the surface layers is related to the prevailing currents. Keeping in mind the picture of the distribution of surface temperature it is readily recognized that the regions of low temperature off the coasts of North America and South America are regions in which the general currents flow from higher to lower latitudes bringing water of low temperature closer to the Equator. In contrast the regions in the western part of the Pacific where extensive warm water masses are found are regions where the general direction of the current is from lower to higher latitudes such that warm water is carried away from the Equator.

The direction of the surface currents corresponds more or less to the direction of the prevailing winds over the different parts of the ocean, with such exceptions as must be expected because of the coast lines. Thus, the relatively narrow and swift Kuroshio off the coast of Japan is not directly related to the local winds but runs in winter partly against the wind, but this current must be considered as the necessary continuation of the North Equatorial Current which flows from east to west under the influence of the prevailing trade winds.

Among the surface currents of the Pacific Ocean there is, however, one which is not obviously related to the prevailing winds nor to the character of the coast lines, and that is the Equatorial Counter Current which is embedded as a narrow and swift current towards the east between the west-flowing North and South Equatorial Currents. The nature of the Equatorial Counter Current has only recently become clearly understood. It is explained as follows by Montgomery and Palmén: The prevailing trade winds exert a stress on the sea surface which, besides contributing towards maintaining the equatorial currents, also lead to a piling-up of light surface water against the western boundaries of the ocean. From oceanographic observations it is evident that such a piling-up takes place because off the American coast the thickness of the warm surface layer is as little as 20 meters, whereas off the Philippines and New Guinea the corresponding thickness is 200 meters or more. As a consequence of this piling-up the sea surface actually rises from east to west, the rise amounting to about 65 centimeters. This sloping surface has not been determined, of course, by precision leveling, but conclusions as to its existence are based on convincing oceanographic evidence. The slope in the trade-wind

regions is balanced by the stress which the wind exerts on the sea surface, but between the trade wind regions lies the equatorial belt of calms where no wind stress acts on the sea surface. Therefore within the calm belt the water must flow downhill from the western to the eastern side of the ocean and the counter current represents this downhill flow. Frictional forces prevent the water from attaining as high velocities as would correspond to a free fall of 65 centimeters. If there were no friction a counter current should reach a velocity of nearly seven knots, that is, seven nautical miles per hour, when approaching the American coast, but the maximum velocity lies between 1 and 2 knots only.

Owing to the friction, a transverse circulation must develop within the counter current, which is quite shallow and confined to movement of the warm surface waters. Theoretical examinations by Defant lead to the result that this transverse circulation should have such character that water is drawn towards the surface at the northern boundary of the current and at the Equator, and sinks at the southern boundary of the counter current. Such a transverse circulation evidently exists in the Pacific, where detailed measurements of temperature, salinity and chemical constituents were made by the *Carnegie* in 1929. This circulation also has an effect on the distribution of organisms because wherever subsurface water is drawn towards the surface, conditions for development of organisms are favorable. The subsurface waters are rich in plant nutrients such as phosphates and nitrates and, when brought near the surface where there is light such that photosynthetic activity can go on, a rich crop of plants will develop followed by large populations of animals. During the crossing of the Equator by the *Carnegie* in 1929 net hauls were made for examination of the microscopic organisms, and according to these the variation in total plankton agreed perfectly with the above reasoning. Maximum amounts of plankton were found at the northern boundary of the counter current and near the Equator, where subsurface water was drawn towards the surface.

The counter current does not appear in the distribution of surface temperatures because it is a feature of the surface layers only, it is a shallow current which is found completely within one uniform climatological area, the Tropics. The other major currents are evident in the distribution of the temperature, as has already been pointed out, but from a chart of the surface temperature and also from a chart showing the character of the surface currents it appears as if all transitions in the ocean are gradual, as if the change in the character of the water when passing from lower to higher latitudes or from west to east

takes place in such a gradual manner that no boundary regions between different currents can be recognized. Examination of subsurface conditions reveals, however, that this impression is quite erroneous and that, on the contrary, well-defined water masses are present separated by relatively narrow regions of transition.

In order to recognize these water masses it is necessary to plot the data from the sea, particularly the temperature and the salinity, in a special manner. The procedure is best illustrated by means of a diagram (Fig. 1). In this diagram are shown the ver-

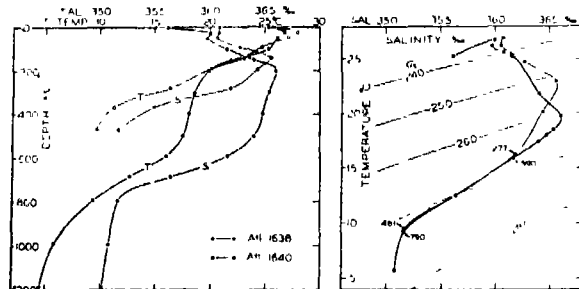


FIG. 1. *Left.* Temperature (T) and salinity (S) at two stations off Onslow Bay, N. C., plotted against depth. *Right.* Temperature and salinity at the same stations plotted against each other.

tical distribution of temperature and salinity at two stations in the Gulf Stream off North Carolina. Examining these curves only there appears to be little similarity between the conditions at the two stations. Thus, at the one which was closest to the coast a temperature of  $15^{\circ}$  was encountered at a depth of 300 meters, whereas at the station at greater distance from the coast the same temperature was encountered at the depth of 650 meters. The discrepancy between conditions at the two stations disappears, however, if the observed temperatures are plotted against the observed salinity, as has been done in the diagram to the right. From this diagram it is seen that the water which at the one station was found to be between the depths of 277 meters and 461 meters is of exactly the same character as that found at the other station between 490 and 790 meters. Or, in other words, a definite relation exists between the temperature and the salinity such that within the same water mass the corresponding values of temperature and salinity fall on a well-defined curve. Therefore, by plotting the observed temperatures and salinity in a diagram one can recognize a given water mass of different character.

Applying this examination to the South Pacific, one finds there several well-defined regions within which typically different water masses are present (Fig. 2), the Subantarctic which occupies the southern part of the ocean and extends along the coast of South

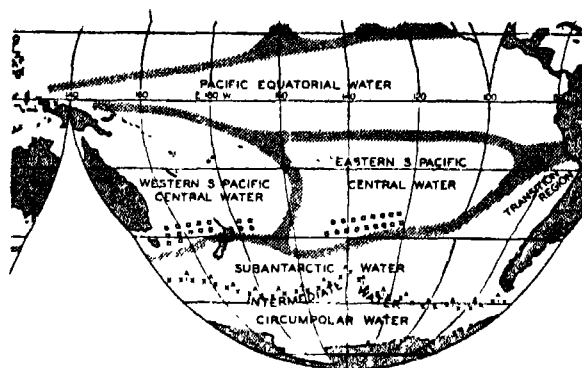


FIG. 2. Regional distribution of the water masses of the South Pacific. Areas in which the central water masses are formed are indicated by squares, area in which intermediate water is formed is shown by crosses.

America to about  $15^{\circ}$ S, the eastern and western Central Water Masses and the Equatorial Water Mass, which is wide in the east and narrow in the west. The character of these water masses is shown in Fig. 3.

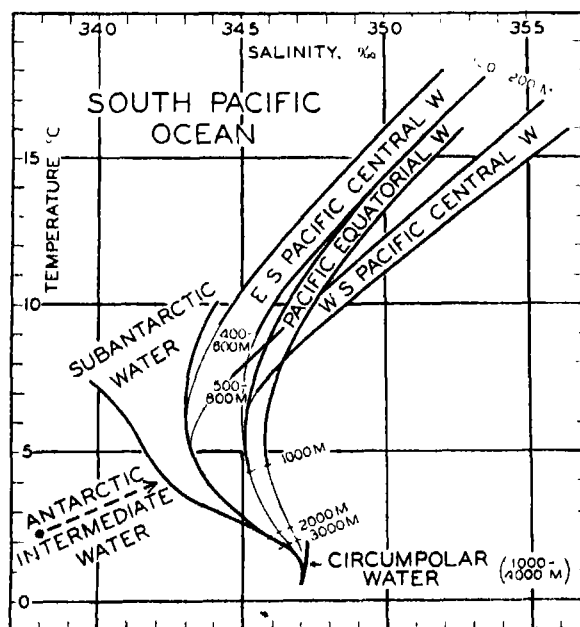


FIG. 3. The water masses of the South Pacific shown in a temperature-salinity diagram.

In this diagram no single T-S curves are entered but, instead, bands are shown, the significance of which is that corresponding values of temperature and salinity fall inside of the lines which represent the boundaries of the bands.

In the diagram the uniform circumpolar water appears as a short piece of a curve because the salinity of that water is nearly constant at  $34.7^{\circ}_{00}$  and the temperature varies only between  $2^{\circ}$  and  $0.5^{\circ}$ . The deep water below the other water masses is nearly

similar to the circumpolar water, as is evident from the fact that all curves converge at their lower ends. Above the deep water the Antarctic Intermediate Water shows up by its low salinity values and above this again are found the other water masses. The Central Water Mass of the Western South Pacific is similar to the corresponding water masses of the Indian and Atlantic Oceans, being formed in a similar manner under similar external conditions. The Eastern Water Mass has a somewhat lower salinity, probably because of admixture of Subantarctic water, and the Equatorial Water Mass is intermediate between the two and must, therefore, mainly originate in the South Pacific.

Turning to the North Pacific, we encounter a similar distribution of water masses. Again two Central Water Masses are present (Fig. 4), one small eastern

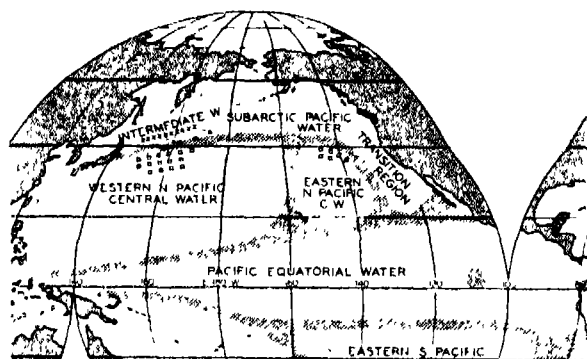


FIG. 4. Regional distribution of the water masses of the North Pacific. Areas in which the central water masses are formed are indicated by squares, area in which intermediate water is formed is shown by crosses.

and one large western, and to the north of them is found a large body of Subarctic water. It may be mentioned here that in the North and South Atlantic and Indian Oceans only one Central Water Mass is present, but in the North and the South Pacific Oceans two are found, probably because these oceans are very wide and because frequently two areas of atmospheric high pressure are present over these seas.

The character of the water masses can be illustrated by a diagram similar to that used for showing the water masses of the South Pacific (Fig. 5). Again, the uniform nature of the deep water is evident from the convergences of the different curves. Above the deep water intermediate water is present, but the formation of this intermediate water is more complicated and in some regions two salinity minima appear. The Central Water Masses are of much lower salinity than the corresponding ones in the South Pacific, indicating that the Equatorial Water Mass must originate in the South Pacific as was already pointed out. The Subarctic Water has a low temperature and a low

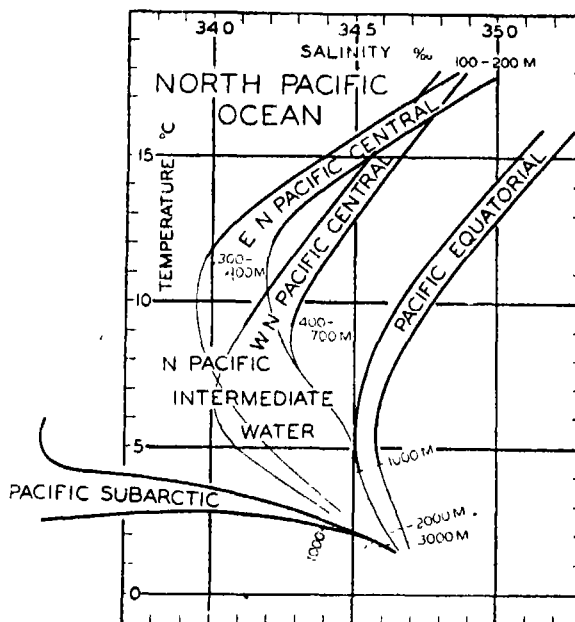


FIG. 5. The water masses of the North Pacific shown in a temperature-salinity diagram.

salinity which increases with depth until the values of the deep water are reached. The one feature to be stressed is that, except for the Eastern North Pacific Central Water Mass, these different water masses are all well defined and all are separated by relatively narrow regions of transition.

The circulation of the North Pacific can now be presented in a more definite manner than by maps showing the surface currents, because a chart can be prepared showing the general direction in which water is transported by the ocean currents and the amounts of water carried by the different branches. Such a chart is shown in Fig. 6 in which the transport by the different branches of the current system is given in millions of cubic meters per second. Thus the maximum transport by the Japan Current is as high as 65 million cubic meters per second, whereas the California Current carries about 10 million cubic meters per

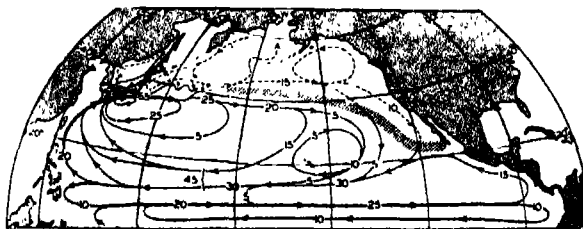


FIG. 6. Transport by the currents of the North Pacific. Lines indicate direction of transport and numbers give volumes of waters expressed as millions of cubic meters per second.

second. As a comparison it may be mentioned that the Mississippi River carries on an average 120,000 m<sup>3</sup>/sec.

The chart shows the equatorial currents between which the counter current is embedded. It shows the intense Kuroshio, which is part of a big gyral in the western Pacific; it shows the presence of a smaller gyral between the Hawaiian Islands and North America, and it also shows how water of the Kuroshio becomes mixed with the cold water of the south-flowing Oyashio such that in the Northwestern Pacific a new water mass, the Subarctic Water Mass, is formed by intensive cooling and by dilution owing to excessive precipitation. This water flows to the east as a cold current, the Subarctic Current of the Pacific, part of which bends south and follows the west coast of the United States and Lower California, until it meets and becomes mixed with the Equatorial waters.

It is not possible to prepare a similar map for the South Pacific because sufficient data are not available, but from the information at hand it is certain that, in general, the currents of the two parts of the ocean are mirror images of each other. The California Current is a counterpart of the Peru Current, which is even more conspicuous and exerts a greater influence upon the distribution of organisms in the sea and upon the climatic conditions.

I have attempted to give a brief review of the structure of the water masses of the Pacific and the relation of prevailing currents to this structure. In conclusion a few words may be added as to the meteorological significance of our increased understanding of ocean circulation and as to the relation of the productivity of the sea to the water masses and currents. It has long been recognized that the oceans exercise a thermostatic control on the climate. The sea receives in summer a great surplus of radiation from the sun and the sky which in that season is mainly used for raising the temperature of the water, and in winter is given off to the air when cold winds blow from the continent, or is used for evaporation. Only recently has it been possible to examine more closely in what regions the heat is given off to the atmosphere and where the maximum evaporation takes place. According to a study which is now in progress, the warm waters of the Kuroshio give off in winter enormous amounts of heat as they flow north, whereas only small amounts are released over the eastern part of the ocean.

Off Japan the maximum amounts of heat given off are greater than 240 gm cal/cm<sup>2</sup>/day, that is, about half the amount which in that region is received in summer. Similarly, the evaporation from the waters of the Kuroshio reaches in winter values greater than 0.8 cm/day, corresponding to a transfer of about 480 gm cal/cm<sup>2</sup>/day of latent heat, or about as much as is

received in summer. Evidently, the exchange of heat and the evaporation from the sea surface is closely related to the oceanic circulation and is very localized. Therefore, in winter the energy for the atmospheric disturbances in middle latitudes is supplied by the sea in restricted areas. These very areas have long been known to be those in which the atmospheric disturbances, the traveling cyclones, are formed, and the present results serve therefore to illustrate the close interaction between the atmosphere and the oceans.

As far as the productivity of the sea is concerned it should be borne in mind that the sea can support large populations of plants and, consequently, provide food to large numbers of animals only in regions where phosphates, nitrates and other plant nutrients are available in the surface layer where so much light penetrates that photosynthesis is possible. Phosphates and nitrates are present in relatively high concentrations in the subsurface layers where organic remains are decomposed, but in the surface layers the available amounts are depleted, owing to the activity of the plants, particularly the microscopic floating plants which represent the main animal food. In order to provide for continued production of plants, water from subsurface depths must be brought to the surface and this takes place in regions of intense mixing, in regions where in winter excessive cooling of the surface layer occurs such that convection currents reaching to considerable depths develop, and in regions where upwelling of subsurface water takes place. Upwelling of subsurface water is particularly conspicuous along the west coast of the United States and off the west coasts of Chile and Peru, and the waters off these coasts are known for their large fisheries. It may be enough to mention that during the last few years an average of about 500,000 tons of sardines have been caught off the American west coast and that according to estimates the amount of fish caught by the guano birds off Peru probably passes 3,000,000 tons a year. Regions of winter cooling and consequently thorough mixing to considerable depths are found in the Gulf of Alaska, around the Aleutian Islands, and in Bering Sea, where again fisheries of the greatest importance take place, and regions of intense mixing and partly of winter cooling are found around Japan, where probably the most intensive fishing in the Pacific is undertaken. The large open ocean areas are not devoid of life, but the populations do not reach such density that fishing operations can be undertaken with success. In the regions which have been mentioned and in regions adjacent to islands where considerable stirring occurs detailed and intensive work has to be carried out in order to learn more about the factors which control the productivity of the

sea and which place a limit on the extent to which the sea can be exploited. At the Scripps Institution of Oceanography we shall for some time to come continue an intensive study of the productivity of the waters off southern California as one of our major objects.

Many of the conclusions which have been presented here are based on meager data, and many features of the picture which has been developed may have to be

modified. Only the average state of the ocean has been dealt with because oceanography has not advanced far beyond the descriptive stage and because the understanding of the processes which maintain the average conditions is still incomplete. The field before us is enormous and it is my hope that in the future increasing efforts will be directed towards further exploration of the largest but least known of all oceans, the Pacific Ocean.

## OBITUARY

### DR. EDWARD KREMERS

ON July 9, 1941, Dr. Edward Kremers, director emeritus of the School of Pharmacy of the University of Wisconsin, died of a heart attack after having undergone some operations (intestinal cancer) with good success. He was seventy-six years of age.

Kremers was born at Milwaukee, Wisconsin, on February 23, 1865, as the scion of one of the German families coming to this country in order to escape the events around 1848. At the School of Pharmacy of the University of Wisconsin he earned his Ph.G. in 1886 and his B.S. in 1888. During his study at Madison Kremers enjoyed the fortune to have as his teacher one of the greatest scientists American pharmacy has presented to the world, Frederick B. Power. Working with Power on the chemistry of volatile oils he learned of the classical investigations executed in the field of phytochemistry by the German chemist Otto Wallach.

In the fall of 1888 Kremers went abroad and became a student with Wallach first at Bonn and later at Goettingen. In Bonn he attended also the lectures on structural chemistry delivered by Kekulé, of benzene ring fame. These two branches of chemistry, i.e., phytochemistry and structural chemistry, have remained the two main fields of Kremers's scientific endeavor throughout his life, and it was in them that he gained world-wide reputation. The dissertation with which he fulfilled the requirements for his Goettingen doctor's degree in 1890 dealt with "The Isomerisms within the Terpene Group" and laid the ground for many later investigations. Returning to Madison, Kremers was instructor in pharmacy from 1890-1892, professor of pharmaceutical chemistry and director of the course in pharmacy at the University of Wisconsin from 1892-1935, succeeding Power.

Being a pharmacist by choice and by destiny Kremers attempted to make pharmacy a profession standing on the same educational level as the other academic callings and to give the pharmacist and the service rendered by him the advantage of special knowledge as well as of a broad general horizon. That is the reason for the fact that he already in 1902

introduced a four-year course in pharmacy, the first of this kind on American soil, and was likewise the first to establish graduate work for students of pharmacy in America leading to the Ph.D. with pharmacy as a major. In 1913 Kremers initiated the first "Pharmaceutical Experiment Station" in the United States, thus demonstrating the possibilities and usefulness of academic pharmaceutical research. Furthermore, it was Kremers who initiated the organization of a Historical Section of the American Pharmaceutical Association in 1902 and created in that way the first organized pharmaceutico-historical group not only in the U. S. A., but in the world. It is likewise very probable that the courses in history of pharmacy as well as of chemistry, announced by Kremers for the first time in 1907-08, were the first of their kind to be held as recognized subjects of instruction at an American university.

Finally, tribute has to be paid to the editor and the author Kremers. From 1896 to 1909 he edited, first together with Frederick Hoffmann and from 1901 alone, *The Pharmaceutical Review*. In 1898 Kremers created another journal restricted exclusively to the publication of scientific originals. This journal, bearing the title *Pharmaceutical Archives*, was discontinued in 1903 and revived in 1936. In 1912 Kremers published his classical brochure on "The Classification of Carbon Compounds," which was reprinted in 1924. He collaborated on the National Standard Dispensatory (1909) and translated Gildemeister-Hoffmann's work on "The Volatile Oils" from the German original into English (1900 and 1913). The pharmaceutico-historical collections of Kremers have formed the main basis for the "Kremers-Urdang History of Pharmacy" published in 1940, the first book containing a systematic survey on the development of American pharmacy.

Kremers served the United States Pharmacopoeia Committee as chairman of the Committee on Volatile Oils from 1900 to 1910 and the American Pharmaceutical Association as chairman of the Scientific Section and as historian. He refused the suggestion to become president of the association, but was made its

honorary president for 1933-34. He was president of the American Conference of Pharmaceutical Faculties in 1902 and of the Wisconsin Pharmaceutical Association in 1930. The National Association of Boards of Pharmacy made him an honorary president for 1939-40. He was, furthermore, an honorary member of the Société d'Histoire de la Pharmacie and of the Deutsche Pharmazeutische Gesellschaft and a corresponding member of the Gesellschaft fuer Geschichte der Pharmazie. He was awarded the Ebert Prize twice, in 1887 and in 1900, and received the degree of Sc.D.h.c. from the University of Michigan in 1913 and the Remington Honor Medal in 1930. Finally, the American Institute of the History of Pharmacy, founded in 1941 on the initiative of Dr. A. H. Uhl in the spirit of Kremers and as an attempt to perpetuate the work and the ideals of this pioneer, made him its honorary president.

On July 6, 1892, Edward Kremers married Miss Laura Haase, of Milwaukee. Of their children three, two daughters and one son, are living, the son, Roland E. Kremers, working with the General Foods Corporation, Hoboken, New Jersey, and a well-known research chemist.

A man of highest merit and achievements as well as

of rare human qualities has left this world. In opening to his profession new ways to science and simultaneously giving to science a new group of adepts he not only has enriched but changed the world of his activities.

GEORGE URDANG

AMERICAN INSTITUTE OF THE  
HISTORY OF PHARMACY

## RECENT DEATHS

DR. RUDOLF SCHOENHEIMER, since 1933 assistant professor and since 1939 associate professor of biochemistry at Columbia University, died by suicide on September 11 at the age of forty-three years.

DR. ALLAN CAMERON FRASER, professor of plant breeding at Cornell University, died on September 17. He was fifty-one years old.

VELLORA M. FOSTER, a geologist in the U. S. Geological Survey assigned to ground-water investigations in Mississippi, died on September 2 at the age of thirty-seven years.

THE death is announced at the age of sixty-eight years of Dr. E. E. Maar, professor of the history of medicine in the University of Copenhagen.

## SCIENTIFIC EVENTS

### CHEMISTRY IN COLLEGE-GRADE DEFENSE TRAINING

CHEMISTRY is included in the new program of college-grade defense training of the U. S. Office of Education, which began on July 1. The new program, described in the *News Edition* of the American Chemical Society, called Engineering, Science and Management Defense Training (ESMDT), is successor to the Engineering Defense Training (EDT) of last year. Besides engineering and chemistry, it includes physics and production supervision (industrial management). The appropriation of \$17,500,000 for defense training was divided as follows: chemistry and production supervision, \$500,000 each; physics, \$100,000; engineering, \$16,400,000. Chemical engineering is included in engineering, and accordingly some types of chemical courses have been given under the old program, but it has not heretofore been possible to offer chemical courses that could not be classed under engineering—e.g., the training of analysts.

Dr. Austin M. Patterson, who retired in June from administrative and teaching work in Antioch College, has been named senior specialist in chemistry education and becomes a member of the Washington staff. Professor Norris W. Rakestraw, of Brown University, has accepted appointment as a member of the National Advisory Committee to represent chemistry. Dr.

Irvin H. Solt, formerly of the University of New Hampshire, will handle physics; Victor S. Karabasz, University of Pennsylvania, is consultant on business management. Dean Homer L. Dodge, of the University of Oklahoma, and Dean Clare E. Griffin, of the University of Michigan, have been appointed members of the National Advisory Committee to represent physics and production supervision.

Dean R. A. Seaton, of the Kansas State College, is director, and Dean George W. Case, of the University of New Hampshire, and Dean Harold M. Crothers, of the South Dakota State College, are the principal specialists in engineering education. Dean A. A. Potter, of Purdue University, is chairman of the National Advisory Committee.

The purpose of the defense training program is to provide, through various universities, colleges and technical schools, short practical courses of college grade to meet the shortage of trained persons in fields essential to the national defense. In most cases these are part-time courses, given in the evening and designed for in-service training, on or off campus, but pre-employment courses are also being given to persons wishing to prepare for a specific job. The Government pays the actual expense of the courses, including teachers' salaries, but the institution contributes its facilities.

The Engineering, Science and Management Defense Training operates through a system of 22 regional advisers, each of whom is chairman of a committee composed of representatives of the participating institutions in that region. It is the duty of these committees to study the needs in their respective regions; the institutions then make detailed proposals of courses to be offered to meet these needs. If these proposals are approved by the Washington office, courses are organized. The courses are not substitutes for the regular ones leading to a degree and are not (with rare exceptions) given for credit.

In the EDT program now nearing completion, more than 100,000 trainees were enrolled in engineering courses. The number of participating institutions was 144, and the estimated cost about \$7,500,000.

#### THE SUBMICROSCOPICAL RESEARCH CENTER AT STANFORD UNIVERSITY

THE Stanford project for the establishment of a submicroscopical research center for which a grant of \$65,000 was made by the Rockefeller Foundation can be divided into three main phases of the work:

(1) Construction of a "service" electron microscope embodying some improvements based on the experience with different actually existing instruments. It will be of such a design that all further developments and improvements can be easily adapted to it. This first instrument should be applied to research projects in the various fields of biology, chemistry, physics, metallography, etc., without forgetting the defense applications of the instrument.

(2) Development of the electron microscope and of all the methods used in conjunction for exploring submicroscopical dimensions. This development program calls for improvements in the resolving power of the electron microscope, improvements in the methods applied for the study of various problems, further physical investigation of the conditions of image formation in the electron microscope, development of auxiliary apparatus and development of any such methods or means which may contribute to the knowledge of the dimensions below the limit of visibility of the light microscope.

(3) With the development of electron optics and electron microscopy, there is an increasing demand for specialized personnel in this new field. The third important task of the research center is the education of such specialists.

#### A NEW BIOLOGICAL LABORATORY IN ALASKA

THE U. S. Fish and Wildlife Service, formerly the Bureau of Fisheries, recently completed the construction of a permanent field laboratory in southeastern Alaska for the study of the natural reproduction of the pink salmon. The laboratory is located at Little Port Walter on the southern tip of Baranof Island, approximately eighteen miles from the open ocean. There is only one stream flowing into the bay at this

location. It originates in a series of mountain lakes and is supplied with a continuous flow of well-aerated water at all times. The bed of the stream varies from sand to large rocks, thus providing opportunity to study the suitability of various types of bottom for the spawning and incubation of the salmon. The entire watershed of the stream, which includes an area of five square miles, has been set aside by the U. S. Forest Service for the exclusive use of the Fish and Wildlife Service.

The populations of pink salmon that reproduce in the stream do not enter the commercial fishery to any great extent and practically all the adults returning from the ocean can be accounted for. By tallying the number of adult salmon that enter the stream each season to spawn and the number of fry that migrate from it to the ocean, it is possible to determine the natural mortality of each year's brood, both in the stream and in the ocean.

The experimental set-up at Little Port Walter consists of a permanent concrete weir by means of which the adult salmon are counted into the stream in the fall of each year and the resulting fry are counted as they migrate from the stream in the spring of each year. Continuous year-round observations are being made of variations in the weather conditions and other natural factors that may influence the survival of each year's brood while in the stream. For this purpose a large laboratory and residence building was constructed at this location which includes a small apartment for the resident biologist and living quarters for the crew necessary in the seasonal operation of the weir. Space is also provided in the building for guest investigators and upon completion of the laboratory facilities accommodations will be available for visiting biologists.

F. A. DAVIDSON,  
*Fish and Wildlife Service*

#### THE USE FOR DEFENSE PURPOSES OF THE BUILDING IN WASHINGTON OF THE NATIONAL ACADEMY OF SCIENCES

DR. FRANK B. JEWETT, president of the National Academy of Sciences, has written a letter to members of the academy which reads as follows:

The purpose of this letter is to advise you concerning developments in the use of the Academy-Research Council Building for scientific work concerned with defense problems.

As you are all doubtless aware the development of the defense program has directed a steadily increasing amount of work to the academy and research council. Present indications are that still further demands will be made on them and their facilities.

In addition to an added burden on the administrative

and operating personnel the most acute problem has been one of space for offices and committee rooms required for a proper carrying on of the work of the academy and research council themselves and of certain scientific work closely associated with that of either the academy or research council.

Early last spring it became necessary to request Science Service to vacate the offices it has occupied for so long and in such pleasant association with the academy and council. Even this move which freed the entire regular office space proved only a temporary solution, however.

By mid-summer overcrowding and further demands were again acute. These demands arose both from the increasing work of the academy and council themselves and also from the needs of two sections in the Office of Scientific Research and Development whose work had to be carried on in close cooperation with the academy and council and in close proximity to the Army and Navy headquarters.

These two sections of the Office of Scientific Research and Development (both headed by members of the academy) are those of the Medical Committee of which Dr. A. N. Richards is chairman and which is intimately associated with the Medical Division of the council, and Section A of the National Defense Research Committee of which Dr. Richard C. Tolman is chairman. The work of this section is directly connected with the work under a contract with the Army of a very active academy committee of which Dr. Tolman is chairman.

Dr. Bush, director of the Office of Scientific Research and Development, made strong formal request for the housing of this and similar work intimately connected with the academy and council in the academy building.

The only possibility of providing this space was the use temporarily of some or all of the rooms now assigned for scientific exhibits. These exhibits are part of the original plan for the building and are a valuable adjunct of the academy and council. At the same time their retention to the detriment of working space urgently needed for defense work was hard to justify.

After a thorough study of the situation the Advisory Committee on Buildings and Grounds has recommended,

and the Executive Committee of the Council has approved, temporary utilization of such of the space as may be required for additional offices. The exhibits removed are to be stored and reinstalled as soon as the emergency is over.

### THE BRITISH ASSOCIATION

PROFESSOR ALVIN H. HANSEN, of Harvard University, consultant of the Federal Reserve System, and Professor Luther H. Gulick, of Columbia University, consultant of the National Resources Planning Board, left on the Atlantic Clipper on September 18 to attend the International Conference on 'Science and the World Order' which is to be held at the Royal Institution, London, on September 26, 27 and 28.

At successive sessions, speakers representing science in Britain and other countries will deal with the following topics (the international aspects to be stressed throughout): September 26, "Science in Government" and "Science and Human Needs"; September 27, "Science and World Planning" and "Science and Technological Advance"; September 28, "Science and Post-War Relief" and "Science and the World Mind."

John G. Winant, United States Ambassador to Britain, will preside at the session on "Science and Human Needs." H. G. Wells will be chairman at the session on "Science and the Human Mind."

Dr. James Bryant Conant, president of Harvard University, has made a phonographic record, for delivery in London, of his comments on the American set-up of science and government and on Anglo-American policy, and Professor Albert Einstein, of the Institute for Advanced Study at Princeton, has made recordings in German and in English for an address on "The Common Language of Science."

At the conclusion of the meeting, the president, Sir Richard Gregory, will announce a charter of scientific fellowship, which has been drawn up by a committee of the division and adopted by the council of the British Association.

## SCIENTIFIC NOTES AND NEWS

THE autumn general meeting of the American Philosophical Society will be held on November 21 and 22, beginning at 10 A.M. on Friday, when there will be "Reports on the Scientific Results of the United States Antarctic Expedition, 1939-41" and on the "Interest of the United States in Polar Lands." In the evening there will be a public lecture followed by a reception. On Saturday morning there will be an open session for the reading of papers and for reports of research that has been aided by grants from the society.

A DINNER in honor of John Dewey was given at the University of Chicago on September 23 as part of the

fiftieth anniversary celebration of the University of Chicago. It was followed by the unveiling of the bust of Dr. Dewey, which has been presented to the university through contributions from friends and admirers and the cooperation of Robert Heckert and the generosity of the sculptor, Alexander Portnoff. The bust is to be placed in the Graduate Education Building in commemoration of John Dewey's service at the university.

ACCORDING to the *Journal* of the American Medical Association, Dr. José A. Saralegui, professor of radiology and physical therapy in the Faculty of Medical Sciences of Buenos Aires and director of the

Municipal Institute for Radiology and Physical Therapy, Buenos Aires, was the guest of honor at a dinner at the University Club, Chicago, on July 28. He is visiting the United States at the invitation of the Department of State.

A MEDAL was recently presented to Dr. Maurice Roch by the Société Médicale de Genève on the occasion of the twentieth anniversary of his professorship of clinical medicine at Geneva.

DR. H. A. MORGAN, who in 1938 succeeded Dr. Arthur E. Morgan as chairman of the Board of Directors of the Tennessee Valley Authority, has been succeeded by David E. Lilienthal. Dr. Morgan, who is now seventy-five years old, will take Dr. Lilienthal's post as vice-chairman. Dr. Morgan was Tennessee state entomologist from 1905 to 1919, was dean of the College of Agriculture from 1905 to 1919 and president of the University of Tennessee from 1919 to 1933, when he became a member of the Tennessee Valley Authority.

DR. ANDREW H. WOODS, professor and head of the department of psychiatry at the College of Medicine of the State University of Iowa, and since 1928 medical director of the psychopathic hospital, has retired.

DR. GEORGE D. STODDARD, since 1929 professor of child psychology and director of the Iowa Child Welfare Research Station, dean of the Graduate School of the State University of Iowa, has been elected by the New York State Board of Regents to succeed Dr. Ernest E. Cole as State Commissioner of Education and president of the University of the State of New York. The appointment will become effective on July 1, when Dr. Cole will retire, having reached the statutory age limit of seventy years.

DR. BUEFORD M. GILE has become acting head of the department of agricultural economics of the Louisiana State University, and Joseph G. Richard has been appointed to succeed Dr. R. J. Saville as assistant director of the Agricultural Extension Division. Mr. Richard has been assistant extension horticulturist with the division since 1935. Dr. Saville will devote his time to research in the Agricultural Experiment Stations, with a minimum amount of teaching.

PROMOTIONS at the South Dakota State School of Mines include the following: Professor E. E. Clark to be acting head of the department of electrical engineering; Professor Guy March to be chairman of the department of mathematics, and Dr. Edward L. Tullis to be professor of geology and head of the department. James D. Bump, instructor in geology, has become director of the museum; Gordon A. Beebe has been promoted to an associate professorship of civil engineering. New appointments include: R. L.

Kidd, assistant professor of mineral dressing, and E. L. Swanson and C. L. Harbison, instructors in mathematics.

DR. ERNEST LUDLOW BOGART, formerly professor and chairman of the department of economics at the University of Illinois, has been appointed lecturer for the current academic year at the New York University School of Commerce, Accounts and Finance. Dr. Bogart, who was president of the American Economic Association in 1931, will offer a course on the economic history of Europe. This course will include a survey of the evolution of agriculture, history and commerce from ancient to modern times, together with a theoretical analysis of important historical economic problems.

DR. ESTHER M. KILLICK, lecturer in industrial physiology at the London School of Hygiene and Tropical Medicine, has been appointed to succeed Dr. Winfred C. Cullis, who has retired with the title emeritus from the professorship of physiology at the London School of Medicine for Women.

THE Jessie Horton Koessler Fellowship of the Institute of Medicine of Chicago, which carries a stipend of \$500, has been awarded for 1941-42 to Dr. Zale A. Yanof, who received his medical degree from Northwestern University in 1937 and his master of science degree in medicine from the University of Chicago in 1941. His work on blood pyruvic acid in heart disease will be carried on in the department of medicine of the University of Chicago.

DR. ROBERT E. WILSON, president of the Pan-American Petroleum and Transport Company of New York, who until August 1 served as petroleum consultant to the Office of Production Management, has been appointed by the Office of Petroleum Coordination a member of the Industrial Refining Committee for the Atlantic Coast.

DR. RICHARD W. NELSON has been appointed chief of the division of forest economics of the Forest Service. He has been acting chief of the division for the past year.

DR. J. A. PINCKARD, associate plant pathologist at the North Carolina Agricultural Experiment Station, has been appointed plant pathologist and head of the department of plant pathology of the Mississippi Agricultural Experiment Station.

DR. CARL C. PFIEFFER, formerly associate professor of pharmacology at Wayne University Medical School, has become associated with Parke, Davis and Company in Detroit, Mich., where he will be at the head of a new section devoted to pharmacological research. Dr. Earl R. Loew, formerly assistant professor of physiology at Wayne University Medical

School, has been appointed research pharmacologist. Both Dr. Pfeiffer and Dr. Loew will continue to lecture at the Medical School.

HARRY MILLER has been appointed head of the chemical section of the Pittsfield Works Laboratory of the General Electric Company. He succeeds R. W. Work, who has joined the staff of the Celanese Corporation of America.

DR. J. ALEJANDRO TÉLLIER has been made Director-General of Health in Bolivia.

*Nature* reports that by an Order of the Committee of Privy Council, made after consultation with the Medical Research Council and with the president of the Royal Society, E. Rock Carling, senior surgeon to the Westminster Hospital, and Professor S. P. Bedson, professor of bacteriology in the University of London, have been appointed members of the Medical Research Council, in succession to Professor G. E. Gask and Professor W. W. C. Topley, who retire on September 30.

DR. ESMOND R. LONG, director of the Henry Phipps Institute of the University of Pennsylvania, is visiting South America on a travel grant awarded by the U. S. Department of State. He was invited by the Government of Colombia to go to Bogota as adviser on the building of a tuberculosis hospital and was later invited to Panama, Costa Rica and Venezuela to lecture on tuberculosis.

DR. ENRIQUE YALOUR, chief of the dairy division of the Argentine Ministry of Agriculture, is visiting the United States to survey the market for Argentine cheese.

DR. CECIL K. DRINKER, professor of physiology and dean of the School of Public Health of Harvard University, will give the Lane Medical lectures at Stanford University from October 6 to 30. The titles of the lectures will be "Physiological Principles Displayed in the Evolution of the Mammalian Circulation"; "The Blood Capillaries of Mammals"; "The Appearance and Elaboration of the Lymphatic Vessels"; "The Blood, the Tissue Fluid and the Lymph as Illustrated by Certain Experiments upon the Heart and Other Organs" and "Some Lessons for Medicine and Surgery."

DR. SAM Z. LEVINE, professor of pediatrics at the Cornell Medical College, gave the address of welcome to incoming students on September 16. He laid stress on the fact that the goal of medicine is no longer merely the prevention and cure of disease, but "the utilization of all measures to promote the health and fitness of all people."

DR. ARTHUR C. DE GRAFF, Samuel A. Brown professor of therapeutics, was the principal speaker at

the opening exercises on September 17 of the New York University College of Medicine.

PROFESSOR OTTO MEYERHOF, of the University of Pennsylvania, formerly of the Kaiser Wilhelm Institute of Physiology at Heidelberg, lectured at Iowa State College on September 19. His subject was "Carbohydrate Metabolism."

UNDER authority of the Executive Committee, notice was given April 23 last, that the 1941 convention of the Association of Land-Grant Colleges and Universities would be held in Washington, D. C., on November 10, 11 and 12. Owing to the congestion which now prevails in Washington and the difficulties under which hotels there are operating, the administrator of the Office of Price Administration and Civilian Supply has requested that conventions be withheld from Washington and that the hotels cancel reservations previously made. In view of this situation, the following change in regard as to the place, dates and headquarters for the convention has been made: The fifty-fifth annual convention of the association will be held in Chicago, on November 10, 11 and 12, 1941; pre-convention dates, November 7 to 9, inclusive. Headquarters will be at the Stevens Hotel.

THE eastern regional headquarters of the U. S. Forest Service has moved from Washington to Philadelphia, in line with the program to decentralize the government's established agencies and to make room in Washington for defense agencies. The new headquarters will be in the Bankers Securities Building, Walnut and Juniper Streets, Philadelphia.

THE Lewis Cass Ledyard, Jr., Fellowship was established in 1939 by a gift from Mrs. Ruth E. Ledyard, wife of the late Lewis Cass Ledyard, Jr., a governor of the New York Hospital. The income, amounting to approximately \$4,000 annually, will be awarded to an investigator in the fields of medicine and surgery, or in any closely related field. This amount will be applied as follows: \$3,000 as a stipend and, approximately, \$1,000 for supplies or expenses of the research. Preference will be given to younger applicants who are graduates in medicine, and who have demonstrated fitness to carry on original research of high order. The research work under this fellowship is to be carried on at the New York Hospital and Cornell University Medical College. The fellowship will be available on July 1 at the beginning of the academic year. Applications for the year 1942-43 should be in the hands of the committee by December 15. It is expected that the award will be made by March 15, 1942. Applications should be addressed to The Committee of the Lewis Cass Ledyard, Jr., Fellowship, The Society of the New York Hospital, 525 East 68th Street, New York, N. Y.

## DISCUSSION

## THE CURRENT LIST OF MEDICAL LITERATURE

ON January 1st, 1941, volume 1, number 1, of the weekly list of current medical literature appeared, and it is potentially by far the most important index of current literature in any scientific field.<sup>1</sup>

Of course the usual indexing and abstracting media are subject bibliographies, and are useful primarily as lists of the prior literature in given fields: as, for example, the *Quarterly Cumulative Index Medicus*, or *Biological Abstracts*. But, there has not been, until the *Current List of Medical Literature* appeared, an exhaustive, classified index to the current literature in any scientific field.

Certainly, the obvious value of this index, and the ease and economy with which it is issued, will mean the prompt appearance of similar indexes in other scientific fields where it is important to have complete lists of the articles occurring in the journals promptly upon their appearance. For example, the publishers of the present indexes and abstracts covering the fields of aeronautics, agriculture, anthropology, astronomy, biology, botany, chemistry, engineering, entomology, geography, geology, meteorology, natural history, ornithology and zoology could easily issue valuable indexes to the current literature in these fields by processes similar to that used in the preparation and publication of the weekly medical list. For that matter, what scholar, in whatever field, would not be pleased to see a weekly, or biweekly, list of all important articles appearing in the journals in his sphere of interest?

The *Current List* is planeographed on 24 pages, and is prepared from cards made primarily for the compilation of the *Index Catalogue of the Library of the Surgeon General's Office*. The cards, representing about 1,000 titles, are withheld from the regular boxes each week, are classified under the 44 groups listed below, and are copied and the typed slips pasted under the proper headings on large sheets, and photographed for the planeograph process. Thus the cost of issuing the weekly edition of 1,000 copies is only \$75.00.

The present expenses are being borne by the Friends of the Army Medical Library, and somewhat more than 400 subscriptions have been entered. Certainly the other 600 needed subscriptions will be forthcoming promptly, or they might very well be if some important corrections are made in the classification of the titles in the *Current List*. It would be most unfortun-

nate to allow this potentially valuable index to lapse. No library with a responsibility in any of the 44 fields covered by the index can be without it, nor can any physician who reads the current literature in his field.

The subjects covered by the index, or, in certain cases, like biology and chemistry, the medical aspects of the subjects, are as follows:

1. Anatomy, Embryology, Morphology
2. Anthropology, Ethnology
3. Bacteriology, Microbiology
4. Biology
5. Cancerology
6. Cardiology
7. Chemistry
8. Dentistry, Stomatology
9. Dietetics, Metabolism
10. Endocrinology
11. Gastroenterology
12. Genetics, Eugenics
13. Gynecology, Obstetrics
14. Histology, Cytology
15. Homeopathy, Osteopathy, etc.
16. Hospital Publications
17. Hygiene, Public Health, Sanitation
18. Immunology, Infectious Diseases
19. Industrial Medicine, Insurance
20. Jurisprudence, Criminology
21. Medical History
22. Medicine, Clinical, Internal
23. Medicine, Laboratory, Diagnosis
24. Medicine, Military and Naval
25. Medicine, Tropical
26. Medicine, Veterinary
27. Neurology, Neurosurgery
28. Ophthalmology, Optics
29. Otorhinolaryngology and Phoniatry
30. Parasitology, Entomology
31. Pathology (general)
32. Pediatrics, Child Welfare
33. Pharmacology, Pharmacy
34. Physiology
35. Psychiatry, Psychology
36. Radiology
37. Societies, Miscellaneous
38. Statistics
39. Surgery
40. Therapeutics
41. Tuberculosis
42. Urology
43. Venereology, Dermatology
44. Zoology

The Army Medical Library receives more than 4,000 journals, about 2,200 of which are indexed in the *Current List*. The indexing includes also monographs,

<sup>1</sup> The *Current List of Medical Literature*. Washington, D. C.: Friends of the Army Medical Library, 1941. Weekly. \$5.00 per year.

transactions, proceedings, etc., but not books, which are listed separately in six or eight Supplements per year, and are classified in 44 groups which vary only slightly from those in the *Current List*.

The articles in the periodicals or journals are listed as they appear in the respective journals; that is, the journal itself, or the group of articles in a particular number of the journal, is classified under one of the 44 subjects shown above. This is the quick way to handle the classification, and perhaps it was felt that until more funds were available it was the practical way. But it is too rough a grouping to be serviceable. Unless a way is found to classify the individual titles of the articles, and not the titles of the journals, the *Current List* will fail to accomplish its purpose.

For example, one finds, in volume 1, no. 6, column 218, "An improved method of applying insecticidal dusts" under the heading of Anthropology, Ethnology. Obviously it was intended to place this title under Entomology, but the classifier misread the title of the journal in which the article appears. See also on the same page, "Weltkreis und Bevölkerungspolitik" under Bacteriology, Microbiology. "Vitamin K in obstetrics," in the same number of the index, column 255, is classified under Societies, Miscellaneous, whereas one might have expected to find it under the thirteenth class, or group, Gynecology, Obstetrics, etc., etc. Such carelessness reflects badly upon the excellent classification found in the *Index Catalogue*.

For a list of the journals received by the Army Medical Library, see the booklet issued by the library in September, 1940: "Medicofilm Service of the Army Medical Library; its purposes and plan of operation, together with a list of more than 4,000 abbreviated titles of medical periodicals currently received by this library."

One of the most valuable aspects of the *Current List* is the microfilming service which it offers. Persons and libraries will, of course, use their nearest medical library having a microfilm camera and other adequate equipment to secure copies of desired articles in the journals, having found the articles by means of the *Current List*. But, in many cases, it will be desirable to use Medicofilm Service, which will send 35 mm microfilms at the rate of 30 cents for articles of 30 pages or less, and 10 cents for each additional 10 pages or fraction. This, of course, is a low price, as compared with the charges of some of the other microfilm services. Medicofilm Service does not state in the booklet referred to above whether 16 mm films are available.

Unfortunately, Medicofilm Service states (v. 1, Supplement 1) that as a rule it does not reproduce recent books or theses or parts of books, "because this is an infringement of the Copyright Law." . . . This may

or may not be a correct interpretation of the law. Why should it not likewise be an infringement to film copyrighted matter in the journals? Also, microfilm copies do not violate the spirit of the copyright act any more than does an interlibrary loan.

Actually, this problem of copyright and microfilming is unsolved. No one knows the answer, but, meanwhile, the principal microfilm laboratories are proceeding to photograph practically anything desired for scholarly purposes, regardless of date or medium—journal, book, or manuscript. The publishers of the journals and books seem more likely to profit than to suffer by this circulation of selected articles or chapters. One hopes that the Carnegie Corporation's proposed report on this subject, now being prepared by a New York City law firm, will remove any such restraint as that which now limits Medicofilm Service.

The Supplements to the *Current List*, referred to above, are of little value, or, rather, are of much less value than they might be if they were classified lists of important new books in the 44 fields of medicine covered by these Supplements. Indeed, one might well expect the Army Medical Library to produce regular classified and annotated lists of new books in all fields of medicine.

Instead, these Supplements are no more than partial lists of recent accessions by the library, many of which books listed are not even remotely concerned with any aspect of medicine. Only those publications for which author cards have been prepared by the library staff, and only those theses which contain 50 or more pages, are listed. Also, the books and theses may be old or new. Their recent accession is the principal reason, the criterion, for entering them in the list—information which can be of very little interest or usefulness to any one.

But, in their own ingenious way, the friends of the Army Medical Library have stumbled upon the most useful kind of index in the field—a weekly classified list of all titles in the principal medical journals of the world; an index published at less than 10 cents per copy. Except for its weird cataloguing, or classifying—which can easily be corrected, the *Current List* is unique and invaluable, and ought to be followed, as said above, by numerous other similar indexes in the sundry fields of science, and perhaps in other fields of current literature; as the social sciences and the humanities, for example.

JOE HARE

UNIVERSITY OF DENVER

### YOUNG SAILFISH

A STUDY of young Pacific sailfish, *Istiophorus greyi*, has been completed, dealing with individuals which I took alive on the Eastern Pacific Zaca Expedition (1937-1938) of the New York Zoological Society.

Both were netted at night lights, one of 84 mm standard length, off Mexico on the night of November 23, 1937, and the other, only 42 mm in length, 1,200 miles farther south, off Costa Rica, on March 1, 1938. These have been compared with equally young Florida sailfish, *Istiophorus americanus*, and with adults of both species.

The study is based on observation of the living and recently dead fish, and on normally preserved as well as stained and cleared specimens. It will appear in a forthcoming number of *Zoologica*, the scientific publication of the Zoological Society.

An interesting feature of the young sailfish, evident at first glance, is that in spite of their diminutive size, they are superficially very much like the full-grown fish. The greatly elongated upper jaw and pelvic fins, the enormous expanse of dorsal fin are as characteristic of the 42 mm specimen as they are of the adult, more than 60 times as long.

When, however, there is added to these externals of the normal, opaque fish, the skeleton and other internal structures, there is found little or no hint of the radical changes to come. These young fish are well balanced, efficiently functioning organisms in their own right. Like most fish they are covered with scales, their jaws are filled with teeth of ordinary pattern, and their two specialized fins seem to impose no unusual activities or habits.

There is no suggestion of the subsequent disappearance of the armor of scales, and their replacement with minute, mucous-canal guards and bony scutes. Without ever having seen the full-grown fish, one would never know that the teeth would all fall out, with the substitution of innumerable sharp and strong dermal denticles covering the whole sword.

The entire head and body will undergo vital changes, together with this radical alteration in the dental armature of the snout, and the consequent shift from a prehensile snapping to a slashing method of attack and feeding. A mobile, twisting body will alter to a stiffened, recoil-guarded handle to the great sword; the parethmoid and other regions of the skull, the vertebrae and caudal complex, the fin bases, the pectoral arch—all will witness an ontologically swift and thorough thickening and extension of ossification. All joints will be stiffened until the whole becomes a taut, tense spring, an organic engine to generate and direct the terrific ramming, hitting and slashing power of the solidly denticled sword.

In the young fish all this excess of bone formation is held in abeyance, adumbrated only, so that the toothed, scaled, prehensile stage of development may function as perfectly as though it would persist throughout the entire lifetime of the fish.

WILLIAM BIERRE

NEW YORK ZOOLOGICAL PARK

## A SUBMERGED MIGRATION ROUTE

BOTANISTS and others have been interested in the presence of southern plants in southeastern Canada and New England. Explanations involve the possibility of a former pathway of migration along the coast, now submerged.

Recently, through the kindness of Mr. George B. Sowers, of Cleveland, the Oberlin Botanical Laboratory has had the opportunity to study two specimens of peat obtained by a contractor working at the Brooklyn Navy Yard. One specimen, an ooze peat deposited under water, was reported to come from 60 feet below the present water-level; the other, a fibrous superficial peat, from a depth of about 40 feet below the present surface. The lowest deposit is described as being overlaid by gravel and underlaid by about 60 feet of clay resting on bed rock. The deposit is said to be continuous and quite extensive along Long Island. Because the samples were obtained in the course of commercial construction work, some difficulty has been experienced in getting the precise relationship of the two specimens examined.

Both, however, have essentially similar pollen spectrums in which deciduous forest pollen predominates, particularly oak and beech. This indicates quite clearly that at the time the peat was formed, deciduous forest conditions prevailed on the then exposed but now submerged surface, presumably affording an opportunity for the northward migration of plants appropriate to deciduous forest conditions.

The pollen examined appears to be slightly less fresh than that in most post-Wisconsin bogs that I have examined but is well preserved. Hickory is present in the lower sample but absent in the upper. Grass and composites are more abundant in the lower; pine more abundant in the upper one and hemlock is present. No hemlock has been found in the lower specimen. This would suggest that the lower specimen was deposited under somewhat more continental conditions than the upper if our information is correct as to the relative depths. Publication of the spectra will be made after further efforts to secure more precise information regarding the stratigraphy.

PAUL B. SEARS

OBERLIN COLLEGE

## THE RELATIONSHIP OF THE AMERICAN PHARMACEUTICAL ASSOCIATION TO THE UNITED STATES PHARMACOPOEIA

SCIENCE for June 20 contains, on page 597, a review by Dr. Charles A. Kofoid of "History of Pharmacy" by Edward Kremers and George Urdang. In this review the following statement is made: "The seventh edition (1962) [of the United States Pharmacopoeia] was the first to be issued under the direct auspices of the American Pharmaceutical Association.

"This statement contains one misprint (1862 instead of 1882) and one misunderstanding. As pointed out in the Kremers-Urdang History the edition of 1882 was prepared under the dominant influence of the American Pharmaceutical Association, and the authors state on several occasions that American professional pharmacy, represented by the American Pharmaceutical Association, took over the patronage and became the guardian of the pharmacopoeial revision work. There is, however, nowhere said that at any time any edition 'was to be issued under the direct auspices of the American Pharmaceutical Association'.

"The issuance of the U.S.P. was prompted first 'By the Authority of the Medical Societies and Colleges' (1820), then 'By the Authority of the General Convention for the Foundation of the American Pharmacopoeia' (New York, 1830) and 'By the Authority of the National Medical Convention' (Philadelphia, 1831). Due to the official participation of representatives of pharmacy in the convention since 1850 the 'Medical' was dropped and it was 'By the Authority of the National Convention for Revising the Pharmacopoeia' that the U.S.P. was issued from 1864 to 1893 (5th to 8th edition). From 1905, *i.e.*, the 9th edition,

finally the U.S.P. has been published by the Authority of the United States Pharmacopoeial Convention."

The official publication of the U.S.P. by the American Pharmaceutical Association as such would not have accorded with the urgent desire the association has had and evidenced at all times to make the U.S.P. the common work of American medicine and pharmacy. The growing active interest taken by official American medicine, represented by the American Medical Association, in the pharmacopoeial revision work has been by no one more welcomed by the American Pharmaceutical Association.

It is of especial historical interest that this voluntary undertaking of one hundred twenty years ago should have continued to eventually become recognized as legal standards by both state and national governments, including several of the Pan American republics. There are probably very few other instances of as long standing where professions have voluntarily chosen to submit themselves to such self-regulation and standardization, possible only under a free system of government.

GEO. D. BEAL,  
Assistant Director

MELLON INSTITUTE OF INDUSTRIAL RESEARCH

## QUOTATIONS

### THE MATHEMATICAL TOOL

THERE can be a bottleneck in mathematics just as surely as in machine tools. And to avoid it requires just as careful a program of long-range preparation. The War Preparedness Committee of the American Mathematical Society and the Mathematical Association of America is right in proposing that grade-school boys of 11 and 12 who have mathematical aptitudes be sought out and encouraged to take courses that will lay the foundation for careers in engineering, physics or directly in the technical branches of the armed forces.

The kind of training here needed is not the kind emphasized in certain New York City high schools which make such a fetish of accurate arithmetic that 100 per cent. is the only passing grade. Such a system may turn out some trustworthy bookkeepers, but it will not develop men with mathematical imagination, men who can use mathematics as a tool to shape out the approximations and compromises that are actually involved in engineering design.

The youthful mind, naturally imaginative, is riper than most pedagogues seem to think for symbols and instruments that offer interesting short-cuts through the drudgery of the multiplication table. The accountant doesn't add or multiply by hand—he leaves it to the calculating machine. The engineer doesn't fill a

page with figures to extract a square root—he reads it from a slide-rule.

Thornton C. Fry, mathematical research director of the Bell Telephone Laboratories, estimates in a new survey of industrial mathematics that in the design of a modern four-engined transport plane about 100,000 hours are spent on mathematical analysis of structures, performance, lift distribution and stability. In calculations of such magnitude short-cuts and approximations are worth money—they may save thousands of hours. Such work, and similar calculations called for in electric power, communications and petroleum prospecting, must be directed by men who have got beyond the bugbears of arithmetic and are not afraid to look a differential equation in the face.

Probably a majority of the people are afraid of mathematics, and that awe is largely traceable to the early, teacher-inspired worry about not getting the example exactly right. Mathematics could be made a fascinating game. The pupil should be encouraged to approximate, or guess, the answer the minute the problem is put before him; then work it out the regular way and see how close he came; and finally check it with a slide-rule or calculating machine. That—skipping the middle stage of all-out arithmetic—is the way the engineer does it.—*The New York Times*.

# SCIENTIFIC BOOKS

## PHYSICS AND PHILOSOPHY

*Between Physics and Philosophy.* By PHILIPP FRANK, visiting lecturer, Harvard University. 238 pp. Cambridge, Mass.: Harvard University Press; London: Humphrey Milford; Oxford University Press. 1941. \$2.75.

THE book comprises a series of articles written for the most part during the last ten years. The writer describes the situation to-day as one in which, after the reign of materialism and naturalism in the nineteenth century, our twentieth century shows a trend away from these movements, and in which the emphasis on the irrational and on metaphysics, the idealistic and spiritualistic interpretation of nature and history are recognized more and more as the prominent features of the century. The author cites the principal aim of his essays as an endeavor to show that one can make use of the recent progress of the physical sciences to the end of supporting the twentieth century trend only if one interprets it according to the pattern of some cherished philosophy, disregarding the scientific meaning of modern physics. A second aim of the book is to make a contribution to the history of the development of "logical empiricism."

The essays center around the development in thought initiated by the "Vienna Circle," which formed about 1910, of which the author was one of the founders, and which sought a stand on which the essential points of Mach's positivism, and especially his stand against the use of metaphysics in science, were retained, while a reconstruction of his doctrines where they stood in opposition to the present course of development of science was attempted.

Following an Introduction in the form of a historical background, the essays comprise the following:

- I. The Law of Causality and Experience (1908)
- II. The Importance of Ernst Mach's Philosophy of Science for our Times (1917)
- III. Physical Theories of the Twentieth Century and School Philosophy (1929)
- IV. Is There a Trend To-day Toward Idealism in Physics? (1934)
- V. The Positivist and The Metaphysical Conception of Physics (1935)
- VI. Logical Empiricism and the Philosophy of the Soviet Union (1935)
- VII. Philosophical Misinterpretations of the Quantum Theory (1936)
- VIII. What "Length" means to the Physicist (1937)
- IX. Determinism and Indeterminism in Modern Physics (1938)
- X. Ernst Mach and the Unity of Science (1938)

It is naturally impossible here to attempt anything of the nature of an exhaustive review of the contents of such a broad scheme of essays. In all of them, however, it is refreshing to find an author talking a language which can form the common ground of the physicist and the philosopher. For these two groups are frequently suspicious of each other, and the former often feels that the latter, having developed his concepts to a point where they cry for more precise meaning that they may take some action in the world, proceeds at this stage to group them into categories and give them names. A name covers a multitude of sins and shrouds its charges with a kind of veil in which they somehow or other seek to claim that all would be clear with regard to them if one had a more precise knowledge of the meaning of the dictionary. And so, even in Professor Frank's book, the physicist is inclined to shudder at so many "isms," but he is happy to find the author shuddering in some degree with him, and prepared occasionally to sympathize with even those whom the strict theoretical physicist must regard as materialistic sinners in his clan. Thus, in contrasting the direct and bold procedure of the practical scientific investigator with the doctrines of the less practical, but critical analysts of the meaning of things, the author very neatly defines the true function of the latter in the words: "My view is that their main value is not that they help the physicist to go forward in his physical work, but rather that they provide the means for defending the edifice of physics against attacks from outside."

In these days, when so much is said about the overthrow of mechanistic principles, it is very refreshing to read such phrases as:

If we say, however, that the mechanical foundation has been replaced by a mathematical one (speaking of relativity and quantum theory), it is, in my opinion, a very inappropriate mode of expression. We ought to say, rather, that the place of a special mathematical theory, that of Newton, has been taken by more general theories, the relativity and quantum theories.

In conclusion, in collecting these essays into book form, Professor Frank is to be congratulated upon producing a work which will be of distinct value to the physicist and the philosopher alike, and one which should broaden considerably the common realms of understanding of these two fields of knowledge.

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## A BACKGROUND TO MUSEUM EXHIBITION

*By Their Works.* By H. PHELPS CLAWSON. 260 pp. 107 illustrations. Buffalo, N. Y.: Buffalo Society of Natural Sciences. 1941. \$4.00.

"*BY THEIR WORKS*" is an interesting and important addition to the growing literature of that nascent social science, museology. The purpose of the volume is to create a historical and cultural setting for an exhibition of anonymous art, drawn from all epochs and all quarters of the globe, on view at the Buffalo Museum of Science. It provides a framework on which to hang an appreciation of the arts of the European Stone and Iron ages, Egypt, the Near East, China, Greece, Indonesia, Australia, Oceania, the Americas, Africa, Luristan, Ordos and the Syro-Hittites. The volume is copiously illustrated, an important feature, since the educated public is more used to two-dimensional visualization in terms of the printed page than to direct appreciation of an object in its three-dimensional reality.

The text is really subordinate to the pictures, or rather to the specimens which they illustrate. There

is no need to cavil at Mr. Clawson for handling his material in this way, since an exhibition speaks for itself and lush verbalization is unnecessary. The examples are on the whole well-chosen and there is a feeling of balance and continuity in the quality of the display. A person who has major interests in any one art field might bawl and scream that some of his pet pieces were left out. The reason many of these finer examples are lacking is that the book is designed to cover only the material available in the Buffalo Museum. Thus "*By Their Works*" fully achieves its basic purpose.

Mr. Clawson has provided a point of reference to the exhibitions which can not be attained through the medium of labels. He has sketched in the social history of the makers of the objects in the display and given the serious visitor a means of preparation for what he is about to see, and a method of conserving the memory of what he has already contemplated. How many museums can claim to have done the same for their clientèle?

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## REPORTS

### THE PROPOSED SOCIETY FOR FREEDOM IN SCIENCE

(1) It is generally agreed that if totalitarian dictators were successful in the present war, they would ultimately put an end to the freedom of scientific research throughout the world. Their pronouncements and their practice alike can leave no doubt upon the point. Defense of scientific freedom, equally with other freedoms, is therefore an integral part of the struggle.

(2) The threat to scientific freedom comes not only from existing dictatorships. Great social changes are inevitable after the conclusion of peace, and some of the changes now ardently advocated in democratic countries contain a definite threat to scientific freedom. There is a widespread and vigorous movement which sees the solution of social difficulties in a complete recasting of the structure of society under a system of central control. Thus there is a threat to scientific freedom, less direct though perhaps as dangerous, from some of the adherents to the doctrine of "central planning."

(3) Science has a value which is independent of the practical benefits it yields to society. The methods of science, its heritage of knowledge and the scientific habit of thought together constitute a scientific culture which must be recognized as being on a par with the artistic and literary cultures; and freedom is essential for all alike. Without freedom science can not flourish,

and therefore can not serve the cultural and practical needs of society.

(4) The threat to freedom in science is believed to be real and dangerous because of the enthusiasm which can be evoked by the doctrine of central planning in the supposed interests of the community. Those who would apply this doctrine to almost every detail of social life represent a school of thought which makes a strong appeal to many of the more active-minded and socially conscious scientists. It seems to be clear that many of the adherents of planning are unaware of the decisive limitations implied by their aims to the freedom and progress of science. Others appear to minimize or to disregard these dangers in their determination to follow the aims of general social planning, whatever its consequences in the province of science.

(5) The vindication of scientific independence is not a doctrine of social indifference but is on the contrary a positive assertion of rights and duties. One of the principal social duties of the scientist is the defense of scientific freedom, for he knows how essential that freedom is for scientific discovery and for the origin of those practical benefits to society which are the natural by-products of his work. At the same time he must recognize the need for continuous reform both in the life of scientific institutions and in the fields where science impinges on society. Almost every professional scientist has some duties apart from pure research; he may undertake teaching, ad-

ministration of a research institution, medical practice, industrial consultation, etc. In fulfilling these duties the scientist should be guided by a realization of their wider social implications and should steadily help to make society more humane, juster and more efficient. Scientists who are prepared to fight for freedom in science are as eager as any one to make contributions to social progress.

(6) In order to maintain scientific freedom in the countries where it still happily exists and to assist in its reestablishment in regions where it is now suppressed, it seems necessary to organize the forces which support the ideal of free science. It is desired to clarify and formulate the ideas involved in the phrase "freedom in science" and to help to support those institutions which now maintain this freedom. If this can be done successfully, a real contribution will be made to the general advance of freedom to which military victory will open the path and which alone can make that victory effective.

(7) The aim of the existing scientific societies as reflected in their publications is almost entirely the direct promotion of research: the independence of science is taken for granted. The Society for Freedom of Science, conscious that this independence is threatened, would work to frustrate the threat.

(8) A nucleus of members has already been secured and it is now desired to build up a large body of scientists, mainly active research workers, who subscribe to the following propositions:

(i) The increase of knowledge by scientific research of all kinds and the maintenance and spread of scientific culture have an independent and primary human value.

(ii) Science can only flourish and therefore can only confer the maximum cultural and practical benefits on

society when research is conducted in an atmosphere of freedom.

(iii) Scientific life should be autonomous and not subject to outside control in the appointment of personnel or in the allocation of the funds assigned by society to science.

(iv) The conditions of appointment of research workers at universities should give them freedom to choose their own problems within their subjects and to work separately or in collaboration as they may prefer. Controlled teamwork, essential for some problems, is out of place in others. Some people work best singly, others in teams, and provision should be made for both types.

(v) Scientists in countries not under dictatorial rule should cooperate to maintain the freedom necessary for effective work and to help fellow-scientists in all parts of the world to maintain or secure this freedom.

(9) Membership of the society involves nothing beyond the support—if necessary the active support—of these principles. It is not proposed, in the first instance at least, to ask for a subscription, though some of the original adherents have contributed money to defray the necessary costs of copying and postage, and such donations are welcome. There is at present a small provisional committee, but it is entirely informal and will resign when the society is sufficiently organized to permit of an election. The present statement has been drawn up by the provisional committee, which is also actively contemplating the publication of a book of essays by several members of the society dealing with various aspects of freedom in science.

(10) Dr. John R. Baker, University Museum, Oxford, to whom the society owes its inception, is acting as secretary. Notices of adherence should be sent to him with any suggestions as to the policy of the society.

## SPECIAL ARTICLES

### WESTERN EQUINE AND ST. LOUIS EN- CEPHALITIS ANTIBODIES IN THE SERA OF MAMMALS AND BIRDS FROM AN ENDEMIC AREA<sup>1</sup>

THE virus of Western equine encephalomyelitis has never been isolated from naturally infected mammals or birds, except man, horses and mules, although attempted by several workers. Howitt<sup>2</sup> noted the presence of antibodies to this virus in a few chickens and one quail. Hammon and Howitt<sup>3</sup> and Hammon<sup>4</sup> noted

<sup>1</sup> From a Cooperative Survey of Encephalitis in the Yakima Valley by the University of California, the State College of Washington, the Washington State Health Department, the Yakima City-County Health Department and the U. S. Department of Agriculture, Bureau of Entomology and Plant Quarantine. Aided by a grant from the National Foundation for Infantile Paralysis, Inc.

<sup>2</sup> B. F. Howitt, *Jour. Infect. Dis.*, 67: 177, 1940.

<sup>3</sup> W. McD. Hammon and B. F. Howitt, to be published.

<sup>4</sup> W. McD. Hammon, *Jour. Am. Med. Ass.*, 117: 161, 1941.

the presence of antibodies in 5 of 9 chickens, 1 domestic duck and 1 of 3 pheasants in an endemic area. The virus of St. Louis encephalitis has been isolated only from man, but neutralizing antibodies were found in horses during the summer of 1940 by Philip, Cox and Fountain,<sup>5</sup> by Howitt and Van Herick<sup>6</sup> and by Hammon and Howitt,<sup>3</sup> and their specificity confirmed and the susceptibility of the horse demonstrated, as a sequel to these findings by Cox, Philip and Kilpatrick.<sup>7</sup> Howitt and Van Herick<sup>6</sup> also found antibodies for this virus in the blood of certain domestic fowl in California.

In the Yakima Valley, Washington, in 1940, evi-

<sup>5</sup> C. B. Philip, H. R. Cox and J. H. Fountain, *Pub. Health Rep.*, 56: 1388, 1941.

<sup>6</sup> B. F. Howitt and W. Van Herick. In press.

<sup>7</sup> H. E. Cox, C. B. Philip and J. W. Kilpatrick, *Pub. Health Rep.*, 56: 1391, 1941.

dence was obtained indicating the probable presence of both the Western equine virus and the St. Louis virus<sup>8</sup> in annual epidemics in man and horses (Hammon,<sup>4</sup> Hammon and Howitt<sup>3</sup>). This is a preliminary report of part of an extensive survey of the same region, started in May, 1941, and continuing during the epidemic of that year, in which the sera from mammals and birds, both domestic and wild, have been tested for the presence of neutralizing antibodies to both of these viruses, and to certain others to be reported later. Word now reaching us of extensive encephalitis outbreaks elsewhere in the West prompted the release of this report while the work was still in progress.

This approach through the neutralization test has proved useful in the study of jungle yellow fever reservoirs, and it seemed likely that as a preliminary survey it would yield more information regarding the extent of infection and possible reservoirs than a search for the actual viruses, since infection has never been manifested by any observed epizootic except in horses, thus differing from the Eastern equine virus.

Bloods were taken with aseptic technique, the serum separated in the field laboratory and shipped in CO<sub>2</sub> ice to the San Francisco laboratory. Tests for antibodies were made by using a carefully pretitrated, stable virus suspension, which was frozen and stored in ampoules at -76 degrees C. The standardized intracerebral technique employed has been described by Hammon and Izumi.<sup>9</sup> A positive for the Western equine virus indicated an ability of the serum tested to protect all mice against at least 10 times the greatest quantity of virus which would permit similar survival in the presence of a negative serum under identical conditions of time, temperature and serum concentration. Similarly, a positive for the St. Louis virus indicated protection against at least a 33-fold increase in virus. Many sera protected against a still greater virus concentration. Positive findings were confirmed by retesting, except in a few instances where the amount of serum available was insufficient. Sera which repeatedly protected only 2 of 4 mice in the higher virus dilution have been classified as questionable and have been omitted from the tabulated data. To date, the sera of 162 birds and 153 mammals have been tested against the St. Louis virus, and of 172 birds and 161 mammals against the equine virus. Those yielding clear-cut results are shown in Tables 1 and 2. No classification other than the categories of "domestic" and "wild" has been attempted.

Before these positive neutralizations may all be

<sup>8</sup> Since writing this, Hammon, Reeves, Brookman, Izumi and Gjullin have isolated the St. Louis virus from mosquitoes of this same area, thus definitely proving its presence (to be published).

<sup>9</sup> W. McD. Hammon and E. M. Izumi, to be published.

TABLE 1  
NEUTRALIZATION TESTS ON SERUM OF BIRDS

	St. Louis		W. Equine	
	Neg	Pos.	Neg.	Pos.
<i>Domestic or in Captivity</i>				
Chicken ( <i>Gallus domesticus</i> )	14	3	14	4
Duck, Common Mallard ( <i>Anas platyrhynchos</i> )	4	1	3	3
Duck, Pekin ( <i>Anas platyrhynchos</i> )	1	0	3	5
Goose, Domestic ( <i>Anser anser</i> )	3	7	4	6
Owl, Great Horned ( <i>Bubo virginianus</i> )	0	3	0	3
Pigeon, Domestic ( <i>Columba livia</i> )	4	7	5	5
Turkey ( <i>Melocapris gallopavo</i> )	3	3	3	5
*Miscellaneous	6	5	6	5
Total domestic	35	35	38	36
<i>Wild</i>				
Blackbird, Brewer ( <i>Euphagus cyanocephalus</i> )	10	0	14	0
Dove, Western Mourning ( <i>Zenaidura macroura</i> )	2	3	6	0
Flicker, Red-shafted ( <i>Colaptes cafer</i> )	1	1	3	1
Hawk, Sparrow ( <i>Falco sparverius</i> )	2	1	1	2
Killdeer ( <i>Oxyechus vociferus</i> )	9	0	5	3
Pheasant, Ring-necked ( <i>Phasianus colchicus</i> )	4	0	3	2
Quail, California ( <i>Lophortyx californica</i> )	0	3	6	3
Robin ( <i>Turdus migratorius</i> )	4	3	4	5
Sparrow, English ( <i>Passer domesticus</i> )	11	0	8	0
Woodpecker, Lewis ( <i>Asyndesmus lewis</i> )	3	0	3	0
*Miscellaneous	13	2	11	0
Total wild	74	13	64	16
Total	109	48	102	52

\* Only one or two examined of each species.

accepted as significant, i.e., the virucidal properties demonstrated to be specific, much further work must be done. We have already studied control series, with significantly different findings in respect to both viruses for horses and cows from Massachusetts, Texas, Arizona and Nevada. Howitt<sup>2</sup> has done the same in California for chickens, turkeys, ducks, pigeons and quail with the equine virus, and for chickens with the St. Louis virus.<sup>6</sup> We have just completed tests with the equine virus on sera of 11 pigeons from Iowa and New York without finding any positives. Controls on a number of other species are being tested. Antibody response to virus inoculation has been demonstrated in the horse for the St. Louis virus (Cox, Philip and Kilpatrick<sup>7</sup>) and for the above-mentioned fowl and certain other birds for the Western equine virus, by Howitt.<sup>2</sup> It would seem probable, therefore, that the antibodies found in many of the species listed in the table are the result of specific infection, probably of a mild or inapparent nature.

It will be noted that for the St. Louis virus, 50.0 per cent. of 70 domestic birds showed protection, as

TABLE 2  
NEUTRALIZATION TESTS ON SERUM OF MAMMALS

	St. Louis		W. Equine	
	Neg.	Pos.	Neg.	Pos.
<i>Domestic or in Captivity:</i>				
Cat, House ( <i>Felis domesticus</i> )	8	0	8	0
Cow ( <i>Bos taurus</i> )	10	6	9	5
Dog ( <i>Canis familiaris</i> )	8	3	6	2
Goat, Domestic ( <i>Capra hircus</i> )	3	3	3	3
Horse ( <i>Equus caballus</i> )	0	12	0 <sup>T</sup>	9 <sup>T</sup>
Pig ( <i>Sus scrofa</i> )	3	1	3	1
Sheep, Domestic ( <i>Ovis aries</i> )	8	2	10	1
*Miscellaneous	8	2	9	2
Total Domestic	48	29	48	23
<i>Wild:</i>				
Chipmunk, Great Basin ( <i>Eutamias minimus</i> )	5	0	6	0
Ground Squirrel, Townsend ( <i>Citellus townsendii</i> )	11	0	12	0
Mouse, Field ( <i>Microtus montanus</i> )	8	0	8	1
Mouse, White-footed ( <i>Peromyscus maniculatus</i> )	2	0	4	1
Pocket Gopher ( <i>Thomomys talpoides</i> )	5	0	4	0
Rabbit, Cottontail ( <i>Sylvilagus nuttalli</i> )	7	1	9	0
Rabbit, Jack ( <i>Lepus californicus</i> )	5	1	10	0
Rat, Brown ( <i>Rattus norvegicus</i> )	4	3	10	0
Rat, Black ( <i>Rattus rattus</i> )	4	1	5	0
Weasel ( <i>Mustela frenata</i> )	4	0	3	2
*Miscellaneous	4	0	3	0
Total Wild	59	6	74	4
Total	107	35	122	27

\* Only one or two examined of each species.

<sup>T</sup> Not vaccinated for Western equine encephalomyelitis.

against 15.0 per cent. of 87 wild; and for the equine virus the respective percentages are 48.7 per cent. of 74 and 20.0 per cent. of 80. Of 77 domestic mammals tested, 37.7 per cent. protected against the St. Louis virus in contrast to 9.2 per cent. of 65 wild, and for the equine virus 32.4 per cent. of 71 domestic as against 5.1 per cent. of 78 wild. Caution is suggested in interpretation of these differences between the domestic and wild animal groups until both the areas of sampling and the species sampling can be more carefully analyzed. However, both the domestic and wild species were collected principally in areas where cases of encephalitis had occurred in 1939, 1940 or 1941. The only species of which an overly large sample was taken, which might exaggerate the above difference, is the Brewer blackbird.

If the apparent significance of these findings is confirmed, it will indicate a much more wide-spread potential reservoir for both viruses than has generally been suspected, especially for the St. Louis virus. It would appear that barnyards and fowl runs, found in large numbers in small towns, rural and suburban areas, are

the principal foci of infection for encephalitis of either the Western equine or the St. Louis type. The distribution of human and obviously of horse cases has conformed with this pattern.<sup>4, 10, 8</sup> Final results, together with other aspects of the survey and with more adequate discussion of the potentialities of the findings, will be published following completion of the survey.

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#### A SYNDROME IN MACACUS RHEBUS AFTER INOCULATION OF STOOL FROM CARRIERS OF POLIOMYELITIS VIRUS<sup>1, 2</sup>

DURING a study of stool specimens from contacts and patients in an outbreak of infantile paralysis in a rural community, certain monkeys (*Macacus rhesus*) that failed to develop anterior poliomyelitis nevertheless showed signs of disease. The clinical symptoms ordinarily appeared from the tenth to the fifteenth day after inoculation. They consisted of some change in behavior, that is, lethargy or excitement, diarrhea and loss of appetite, associated with a slight febrile temperature lasting from twenty-four to forty-eight hours. After it became apparent that such mild illness followed stool inoculation and that the incubation period compared closely with that in monkeys developing poliomyelitis, all animals were killed and autopsied after the twenty-first day following inoculation.

Tissue was taken from the following regions of the

<sup>10</sup> *Public Health Bulletin*, No. 214, 1935.

<sup>1</sup> A preliminary report.

<sup>2</sup> Aided by a grant from the National Foundation for Infantile Paralysis, Inc.

central nervous system: the intervertebral ganglia; the sympathetic chains; the ganglia of both vagus nerves external to the skull; the Gasserian ganglia; the olfactory bulbs; the sacral, lumbar, upper and lower dorsal, and cervical regions of the spinal cord; from the medulla; the mesencephalon; the diencephalon, and from each of the major lobes of the cerebral cortex of both hemispheres of the brain, as well as from the cerebellum, including the roof nuclei. These tissues were fixed immediately in 70-per-cent. alcohol and the sections eventually stained with thionin.

It was observed that lesions resembling those ordinarily found in the intervertebral ganglia in cases of typical anterior poliomyelitis were also present in the intervertebral ganglia of most of these monkeys. Moreover, similar lesions were almost invariably present in the large-celled portion of one or both vagus ganglia and, rarely, in one or both Gasserian ganglia. The lesions varied from extremely mild, doubtful ones to florid pathologic changes. They consisted of focal interstitial ganglionitis, with focal destruction of neurons and neuronophagia. Some degree of perivascular "cuffing" was usually present. The exudative cells were predominantly mononuclear types. These lesions followed intraperitoneal inoculation of treated stool from patients with clinical anterior poliomyelitis or from contacts. If, in addition to the intraperitoneal route, stool was exhibited to monkeys intranasally, then lesions of the olfactory bulbs sometimes occurred. In the olfactory bulbs, the lesions consisted of perivascular "collaring" with foci of cell necrosis and exudative accumulations principally in the mitral-cell layer. Degeneration of mitral cells had occurred, and although neuronophagia was not always easy to identify in the manner that one does in anterior-horn cells, evidence of it appeared to be present. No changes were noted in sections that were studied from the remainder of the central nervous system of these animals.

In the seven instances in which this syndrome was observed, other monkeys were subsequently inoculated with larger doses of the original stool specimens. In five of the seven, a monkey eventually contracted classical anterior poliomyelitis. Sometimes as many as four attempts in as many monkeys, with repeated occurrence of the mild disease described, were necessary to achieve, in one monkey, the accepted end-point, that is, fever, flaccid paralysis and anterior-horn cell necrosis with neuronophagia and perivascular "cuffing." In one case, stool inoculation, intranasally and intraperitoneally, was made in two different monkeys. Although neither developed typical poliomyelitis, both showed lesions in the vagus and spinal ganglia and in the olfactory bulbs. The patient from whom this specimen of feces was obtained had

clinical poliomyelitis. In the seventh instance, no illness and no lesions were obtained after the inoculation was repeated.

It is common knowledge that a characteristic pathologic picture may be found in intervertebral ganglia and olfactory bulbs in experimental and human anterior poliomyelitis. That similar changes may be present in the ganglia of the vagus nerves is not usually recognized. It may be opportune at this point to call attention to a publication of Goodpasture in 1925,<sup>1</sup> in which, after studying tissue obtained at autopsy from a patient with "polio-encephalomyelitis," he makes the following statement: "A case of polio-encephalomyelitis in a boy is described in which medullary lesions were found which appear to be directly related to the central distribution of the ninth and tenth cranial nerves. It is suggested that the virus of poliomyelitis in human infections may enter the brain through peripheral nerves."

Further work is in progress to determine whether or not the syndrome described is truly atypical anterior poliomyelitis, and what possible significance lesions of the vagal ganglia may have. However, these observations demonstrate the necessity of killing and examining all inoculated monkeys.

#### SUMMARY

A mild clinical syndrome in *Macacus rhesus*, accompanied by pathologic changes in the sensory portions of the vagus ganglia, intervertebral ganglia, and sometimes in the Gasserian ganglia is described. This syndrome occurred following intraperitoneal inoculation of fecal material obtained from contacts and from patients with infantile paralysis in an epidemic in a rural community. When intranasal as well as intraperitoneal inoculation was practiced, the olfactory bulbs were sometimes involved.

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#### RESYNTHESIS OF BIOTIN FROM A DEGRADATION PRODUCT<sup>1</sup>

In a forthcoming paper<sup>2</sup> we are presenting data which indicate that biotin ( $C_{10}H_{16}O_2N_2S$ ) is a cyclic urea derivative. The basis of this conclusion was the formation of a diaminocarboxylic acid ( $C_9H_{15}O_2N_2S$ ) from biotin by the action of  $Ba(OH)_2$  at  $140^\circ$ . The loss of one carbon atom and one oxygen atom, the

<sup>1</sup> E. W. Goodpasture, *Amer. Jour. Path.*, 1: 29-46, 1925.

<sup>2</sup> We wish to thank Mr. W. O. Frohring, of the SMA Corporation, for supplies of biotin concentrates used by us in the preparation of the crystalline biotin and for a research grant which has aided us in this work.

<sup>3</sup> K. Hofmann, D. B. Melville and V. du Vigneaud, *Jour. Biol. Chem.*, 141: 207, 1941.



ing manometer arm. The resistor is often represented diagrammatically as a short capillary, but in practice it takes on a variety of forms, for a simple short section of capillary glass tubing in the readily available bore sizes often fails to provide enough resistance.

The most frequently adopted way of obtaining high resistance, no doubt, is to use a long capillary, sometimes an unwieldy bundle of tubes several meters in total length. A common alternative is to decrease the diameter for part of the path by reworking the glass to form a constriction; a compact element results, but the danger of clogging is increased. A resistor that is both compact and nonlogging may be formed by packing small-bore glass tubing with fine sand, preferably narrowly fractionated as to size—say, 200–325 mesh—and washed free of dust. A resistor recom-

mended by Bruun<sup>1</sup> comprises a short capillary tube containing an exchangeable wire, different magnitudes of resistance being obtainable by use of different sizes of wire in the same tube.

All these types of resistors have one feature in common that is sometimes a serious drawback. When for purposes of standardization it is desirable to have precisely a given amount of resistance, accurate construction is at best a tedious job, and in some cases practically impossible. This fault is obviated in the device described below.

In this resistor (Fig. 1), as in that of Bruun, resistance is effected by a short capillary containing a corrosion-resistant wire. Unlike Bruun's device, however, the wire (W) extends through somewhat less than the whole length of the glass capillary tube (T), the length of the inserted portion being determined roughly in advance by calculation and subsequently corrected experimentally to a close approximation. The protruding end of the wire is soldered to one end of an adjusting screw (A), which fits within an inside-threaded metal tube (M). The screw is grooved on the other end for operation with a screw driver, and is cut down flat throughout its length on two opposite sides to allow free passage of air through the metal tube. The glass and metal tubes are ap-

proximately the same in outside diameter, and are connected closely by one ( $R_1$ ) of three similar short sections of heavy-wall rubber tubing. The other two sections ( $R_2$ ,  $R_3$ ) are slipped around the glass tube and the metal tube, respectively, some distance from the connecting section ( $R_1$ ). A sheath (S) of springy sheet metal nearly surrounds the three rubber-tube sections, which it grips firmly by reason of its tension, and thereby serves as a splint to hold the assembly rigid. A ready-made article that lends itself admirably to use as the sheath is the spring element of a well-known type of paper clip.

The resistor may be installed in the flowmeter by the use of one or two connections of rubber tubing, depending on whether or not one end is to be left open to the atmosphere. When the assembly is otherwise complete, the wire, having been cut originally somewhat too long, is clipped down to give as nearly as possible the correct resistance when the adjusting screw is about midway between the ends of the threaded tube. Fine adjustment can then be made by turning the screw.

It should be pointed out that in a capillary containing a wire, where both are perfectly straight, the resistance will depend on how nearly centered they are with respect to each other. In practice, however, if the wire is nearly as large as the bore, the tendency of the former to kink will prevent any troublesome variation of the resistor as a whole.

This device has a wide field of usefulness, has a material cost of only a few cents, and is easily constructed without special tools.

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- BAITSELL, GEORGE A. *Manual of Biology*. Sixth edition. Pp. ix + 449. 12 plates. Macmillan. \$2.75.
- Bicentennial Conference of the University of Pennsylvania: BOWEN, NORMAN L., JOSEPH A. CUSHMAN and ROY E. DICKERSON. *Shiftings of Sea Floors and Coast Lines*. Pp. 30. NOYES, W. ALBERT, JR., HUGH S. TAYLOR and WALTER A. JACOBS. *Chemical Kinetics and Natural Products*. Pp. 41. MYERS, CHARLES S., FRANK N. FREEMAN and MORRIS S. VITELES. *Modern Psychology*. Pp. 48. University of Pennsylvania Press, Philadelphia. Each, \$0.50.
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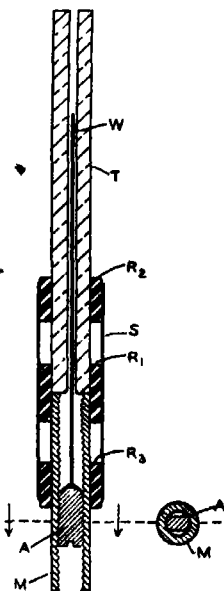


FIG. 1. Resistor in longitudinal section, with cross section of threaded parts.

<sup>1</sup>J. H. Bruun, *Ind. Eng. Chem., Anal. Ed.*, 11, 655 (1939).

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## THE METAL CARBONYLS<sup>1,2</sup>

By Professor ARTHUR A. BLANCHARD

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

THIS meeting is to do honor to a man who was a great scientist, who was later, also, a great administrator, and who, when he reached the age when he could surrender his administrative duties and could enjoy the leisure and rest which he had so fully earned, chose to devote his great energy to the cause of the orderly development of the science of chemistry he loved. Edgar Fahs Smith exemplified the most truly scientific attitude towards chemistry. He championed the importance of accurate finding and recording of facts, and he encouraged the use of theories only as

they helped to clarify and classify the facts. A favorite remark of his was to the effect that theories come and theories go, but facts live on forever.

It is, I think, entirely fitting that I should do honor to Professor Smith in telling you the facts about an unusual class of substances, the metal carbonyls, in which I have taken a particular interest, and to show how certain generalizations have helped to some extent to classify and define the relationship among the carbonyls.

### NICKEL CARBONYL

Nickel carbonyl was discovered by Mond in 1890, and iron pentacarbonyl was discovered shortly thereafter. These strange substances were a challenge to

<sup>1</sup> Edgar Fahs Smith Memorial Lecture at the University of Pennsylvania May 23, 1941.

<sup>2</sup> Fairly complete literature references may be found in *Chemical Reviews*, 21: 3, 1937, and 26: 409, 1940.

the intelligence of chemists, for, except for the law of definite proportion, they violated every generalization known to chemists at that time.

Nickel carbonyl is formed by the direct combination of carbon monoxide with metallic nickel. Spongy nickel, freshly prepared by gently heating nickel formate in hydrogen, will at room temperature take on carbon monoxide greedily with the formation of nickel carbonyl,  $\text{Ni}(\text{CO})_4$ . On the other hand, compact nickel which has been in contact with the air will not react perceptibly with carbon monoxide. It is this fact which explains why the carbonyls were not discovered earlier.

Nickel carbonyl is a water-white, very mobile and very volatile liquid. It has about the same volatility as ethyl ether, and since inhaling traces of its vapors causes death or incurable impairment of the nerves and the vital organs, it should never be handled except with extreme caution.

Nickel carbonyl forms at room temperature; it also dissociates at moderate temperatures. It is interesting to observe a delivery tube in the open laboratory through which carbon monoxide laden with nickel carbonyl vapor is passing. A thin layer of metallic nickel may deposit on the inside of the tube as a brilliant mirror. Perhaps soon the load of nickel carbonyl vapor may fall off and nearly pure carbon monoxide will be passing. In such a case the black mirror will appear to evaporate.

Nickel carbonyl meets the definitions of a chemical compound. Nickel and carbon monoxide unite in definite proportions and the physical properties of the compound are totally different from the properties of either nickel or carbon monoxide. Yet chemically nickel carbonyl behaves like uncombined nickel on the one hand and like uncombined carbon monoxide on the other hand.

Chlorine and bromine react instantly and quantitatively with nickel carbonyl, forming nickel halide, and all the carbon monoxide is set free. Iodine, sulfur and oxygen react similarly, although not quite so decisively. On the other hand, when nickel carbonyl is inhaled and gets into the blood stream, carbon monoxide instantly combines with the hemoglobin and free nickel is left. It is, in fact, this colloidal nickel in the blood which is so destructive. With Grignard reagents nickel carbonyl reacts instantly with a precipitation of black nickel and the formation of the compounds that would be expected from the reaction of carbon monoxide and Grignard reagent. Nickel carbonyl is insoluble in water but generally soluble in all proportions in organic solvents. It is unattacked by dilute acids and alkalis.

#### VOLATILE CARBONYLS

The description of the method of formation and

of the chemical and physical properties of nickel carbonyl could be applied with only minor modifications to all the metal carbonyls.

The closest analogy to the type of chemical combination existing in the carbonyls is shown by hydrates, which dissociate easily into water and anhydrous salts.

To-day we have quite an impressive list of volatile carbonyls, as shown in Table 1; the volatility is sufficient for molecular weight determinations to be made by the vapor density method at temperatures generally below 100° centigrade.

TABLE 1  
VOLATILE CARBONYLS

Compound	Vapor pressure mm	begins to decompose at °C
$\text{Ni}(\text{CO})_4$	261 at 15° C	60
$\text{Fe}(\text{CO})_5$	15 at 25° C	150
$\text{Ru}(\text{CO})_5$	Very volatile	-15
$\text{Cr}(\text{CO})_6$	1.0 at 48° C	130
$\text{Mo}(\text{CO})_6$	2.3 at 55° C	150
$\text{W}(\text{CO})_6$	1.2 at 67° C	150
$\text{Co}(\text{CO})_8\text{NO}$	56 at 16° C	< 100°
$\text{Fe}(\text{CO})_5(\text{NO})_2$	4.5 at 0° C	< 50°
$\text{Co}(\text{CO})_4\text{H}$	Very volatile	-33°
$\text{Fe}(\text{CO})_4\text{H}_2$	11 at -10° C	< -33°
$\text{Re}(\text{CO})_5\text{Cl}$	sublimes at < 100° C	> 100°

#### IMPORTANCE OF THE PROPERTY OF VOLATILITY

The property of volatility was one of the first of the properties of matter to be recognized. In the interesting old prints taken from the time of the alchemists we always find the alembic (or still) prominently displayed, thus showing the importance attributed to the property of volatility by the earliest scientists.

To-day the enthusiasm for the more recently recognized properties of matter is so great that I believe that the simple but important property of volatility is too much neglected. I refer to such properties as x-ray diffraction, absorption and emission spectra (both x-ray and optical), electron diffraction, magnetic susceptibility, dielectric constant, Raman spectrum and, perhaps the newest of all, resonance, which in fact is not a property at all but rather an imaginary condition remotely related to those properties that can be measured experimentally.

Volatility signifies lack of cohesion between molecules. There is really little fundamental difference between chemical affinity and cohesion. We are accustomed rather arbitrarily to regard the phenomenon as due to chemical affinity when we find definite proportion, and simply as due to cohesion when the proportions are variable. But both chemical affinity and cohesion are due to the same cause, namely, the field of atoms and molecules and ultimately the field of the nucleus and electrons within the atom.

With the inert gases the tremendous fields of the nucleus and electrons almost completely neutralize each other or, in other words, the lines of force are

completely closed within the atom, and neither cohesion nor chemical affinity are manifest to any marked extent. The atoms of all other elements possess external fields. Where definite groups of atoms can form in which the fields of the different atoms are mutually neutralized, there is little cohesion between the molecules and the compounds are volatile. Thus when we try to study the nature of valence and chemical affinity among the volatile carbonyls the problem is simplified in that all the forces are self-contained within the molecule.

#### VALENCE AND EFFECTIVE ATOMIC NUMBER

The concept of valence was first introduced to clarify the distinction between atomic and equivalent weights, and at that time no cognizance was taken of the polarity of valence. The knowledge of the hydrocarbons rendered the whole number concept of valence untenable without the employment of new postulates of molecular structure. The development of electrochemistry necessitated the assignment of polarity to valence and thereupon arose the contradictions between polar and non-polar valence which seemed impossible of reconciliation until after the postulates of the electronic constitution of atoms had been introduced. In 1916 G. N. Lewis offered the seemingly absurd suggestion that pairs of electrons could at the same time fill positions in the outer electron shells of two atoms. Atoms are prone to gain or lose electrons until the number in the outer shell or valence layer is eight. Langmuir in 1919 contributed largely in clarifying this "octet" theory of valence. C. R. Bury in 1921 extended this theory to the heavier elements, and showed more specifically how the inert gases served as the fixed reference points of the theory, but how the elements in the mid-parts of the long periods might possess variable atom kernels.

Later Sidgwick, in the course of the study of complex ions, introduced the term "Effective Atomic Number" (E.A.N.) to denote the total number of electrons, both shared and unshared, possessed by an atom. The electronic valence theory as developed by Lewis, Langmuir and Bury may be simply stated in terms of E.A.N. All elements tend to enter the state of combination in such a way as to make the E.A.N. coincide with that of an inert gas.

If this rule is applied to the volatile carbonyls, it is found that in each case the E.A.N. of the central atom is that of an inert gas if in counting the E.A.N. we adopt the reasonable postulates that each carbon monoxide molecule donates two electrons, each nitric oxide molecule donates two electrons and transfers one electron, each hydrogen atom donates one electron and each chlorine atom withdraws one electron to acquire its own octet and then donates or shares two of its octet.

TABLE 2  
EFFECTIVE ATOMIC NUMBERS

BH <sub>3</sub> CO	5 + 3 + 2	10	Ne
Ni(CO) <sub>4</sub>	28 + 8	36	Kr
Fe(CO) <sub>5</sub>	26 + 10	36	Kr
Ru(CO) <sub>5</sub>	44 + 10	54	Xe
Cr(CO) <sub>6</sub>	24 + 12	36	Kr
Mo(CO) <sub>6</sub>	42 + 12	54	Xe
W(CO) <sub>6</sub>	74 + 12	86	Rn
Co(CO) <sub>4</sub> (NO)	27 + 6 + 3	36	Kr
Fe(CO) <sub>4</sub> (NO) <sub>2</sub>	26 + 4 + 6	36	Kr
Co(CO) <sub>4</sub> H	27 + 6 + 1	36	Kr
Fe(CO) <sub>4</sub> H <sub>2</sub>	26 + 8 + 2	36	Kr
Re(CO) <sub>5</sub> Cl	75 + 10 - 1 + 2	86	Rn

It is noteworthy that nickel carbonyl, Ni(CO)<sub>4</sub>, which is the most volatile of all the carbonyls, is the only carbonyl of nickel.

If monomeric tetracarbonyls or iron and cobalt were to exist, the E.A.N. would not be 36. But the modifications of tetracarbonyls, Fe(CO)<sub>2</sub>(NO)<sub>2</sub>, Fe(CO)<sub>4</sub>H<sub>2</sub>, Co(CO)<sub>3</sub>(NO) and Co(CO)<sub>4</sub>H, all of which are known and are very volatile, do show an E.A.N. of 36 for the central atom. Furthermore, iron and cobalt are prone to form polymeric tetracarbonyls, [Fe(CO)<sub>4</sub>]<sub>3</sub> and [Co(CO)<sub>4</sub>]<sub>2</sub>, which are only very slightly, if at all, volatile. To iron and cobalt in these polymers we may easily ascribe the E.A.N. of 36 by properly placing the shared electrons which bind the polymers together.

A complete list of the polymeric carbonyls is given in table 3.

TABLE 3  
POLYMERIC CARBONYLS

Fe <sub>3</sub> (CO) <sub>9</sub>
[Fe(CO) <sub>4</sub> ] <sub>3</sub>
[Co(CO) <sub>4</sub> ] <sub>2</sub>
[Co(CO) <sub>4</sub> ] <sub>3</sub>
Ru <sub>3</sub> (CO) <sub>9</sub>
[Ru(CO) <sub>4</sub> ] <sub>3</sub>

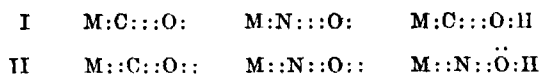
Of these, the enneacarbonyls, Fe<sub>3</sub>(CO)<sub>9</sub> and Ru<sub>3</sub>(CO)<sub>9</sub>, and the tetracarbonyl [Co(CO)<sub>4</sub>]<sub>2</sub> may be sublimed without decomposition, but all the molecular weights are determined only by the freezing point lowering method in organic solvents.

#### METAL CARBONYLS AS COORDINATION COMPOUNDS

It is interesting to note that Albert Werner's system of coordination was first proposed at about the time of the discovery of nickel and iron carbonyls. However, it was some time before it was realized that the carbonyls fitted into this system. The earlier grotesque attempt to assign a structure to the carbonyls would often postulate ring structures with the metal atom a member of the ring. However, when the coordination system began to assume the stature of a real theory, through the application to it, notably by Sidgwick, of the newly developed ideas of the electronic structure of matter, it became apparent that the carbonyls belonged properly in the coordination theory with the metal atom in the center of the co-

ordinate group. A notable difference between the carbonyls and all other coordination complexes remained, however, in that the valence (electrovalence) of the metal atom of the carbonyls is zero, whereas always the valence of the metal atom in other complexes is a positive number.

The central position of the metal-atom in the carbonyl complex is supported by recent studies of electron diffraction, which indicate that: in the compounds with four addenda the four groups are situated at the corners of a tetrahedron surrounding the metal atom; in the penta carbonyls the structure is that of a trigonal bipyramid and in the hexacarbonyls the structure is octahedral; the atom arrangement M-C-O and M-N-O form straight lines, the hydrogen atoms lie at the end of the chain M-C-O-H; and the bond distances are such as to be in harmony with a condition of resonance between the structures



The extreme resemblance of carbon monoxide and nitric oxide in physical properties is taken to indicate a similarity in constitution. The most commonly accepted electronic structure of carbon monoxide is shown in the formula



Nitric oxide has one more electron, which is somehow tucked away in the molecule without a profound effect on the physical properties. When coordination of carbon monoxide with a metal atom takes place, the lone pair on the carbon atom enters the coordination layer of the metal atom and thus the E.A.N. of the metal is increased by two. When nitric oxide coordinates, the lone pair of the nitrogen atom enters the coordination layer of the metal atom and the extra electron of the nitric oxide is transferred completely and thus the E.A.N. of the metal is increased by three. In the resonating structures it is to be noted that two of the electrons of the double bond between the metal and carbonyl group or the metal and the nitrosyl group came from the metal so that the E.A.N. of the metal and, in fact, of the carbon oxygen and nitrogen, remains unchanged by the resonance.

When, a moment ago, we spoke of zero valence in the carbonyls we spoke in rather vague terms although we would probably be understood in the sense that was intended. Whenever water molecules (in hydrates), cyanide ions (in complex ions), carbon monoxide molecules (in carbonyls), coordinate, the coordinating electrons are counted as still belonging exclusively to the addenda when the polar valence of the central atom is counted and thus the valence becomes the difference between the atomic number (nuclear charge)

and the number of electrons inside of the coordinate layer. According to this method of counting, the valence of the metal would be zero in  $\text{Ni}(\text{CO})_4$ ,  $\text{Fe}(\text{CO})_5$ ,  $\text{Cr}(\text{CO})_6$ ,  $\text{Mo}(\text{CO})_6$ ,  $\text{W}(\text{CO})_6$ , but it would be minus one in  $\text{Co}(\text{CO})_3\text{NO}$  and  $\text{Co}(\text{CO})_4\text{H}$  and minus two in  $\text{Fe}(\text{CO})_2(\text{NO})_2$  and  $\text{Fe}(\text{CO})_4\text{H}_2$ .

No one should disagree with the appraisal of such valences as the height of absurdity. We have simply illustrated the seeming absurdities we reach when we give the result of our own counting of valence if we do not very exactly specify our method of counting.

#### NON-VOLATILE CARBONYLS

In addition to the volatile carbonyls there are a great many complex compounds or salts in which carbon monoxide and nitric oxide are present and obviously bound as coordinated addenda in the same manner as in the volatile carbonyls. Table 4 contains a list of some of the more important of these where X stands for a halogen atom.

TABLE 4  
NON-VOLATILE CARBONYL AND NITROSYL COMPLEXES

$\text{CuX} \cdot \text{CO}$	$\text{AuCl} \cdot \text{CO}$
$\text{CuX}_2 \cdot \text{NO}$	$\text{FeI} \cdot 2\text{NO}$
$\text{RuX}_2 \cdot 2\text{CO}$	$\text{CoI} \cdot 2\text{NO}$
$\text{RuBr} \cdot \text{CO}$	$\text{Ag}_2\text{SO}_4 \cdot \text{CO}$
$\text{PdCl}_2 \cdot \text{CO}$	$\text{RhCl}_2 \cdot \text{RhO} \cdot 3\text{CO}$
$\text{OsX}_2 \cdot 3\text{CO}$	$\text{RhCl}_2 \cdot \text{RhO} \cdot 3\text{NO}$
$\text{IrCl}_2 \cdot 2\text{CO}$	$\text{FeSO}_4 \cdot \text{NO}$
$\text{PtCl}_2 \cdot \text{CO}$	$\text{CO} \cdot \text{Hg}(\text{OC}_2\text{H}_5)(\text{COOCH}_3)$
$2\text{PtCl}_2 \cdot 3\text{CO}$	

Some of these compounds may be sublimed without decomposition but none have an appreciable volatility at ordinary temperatures. There is no apparent dependence of these compounds upon the effective atomic number, but since these compounds are not volatile and the molecular weight of few of them has been determined, it is impossible to draw definite conclusions whether the E.A.N. is or is not a dominating factor in their existence.

#### COMPLEX IONS AND EFFECTIVE ATOMIC NUMBER

At all events the effective atomic number is very clearly a dominant influence in the formation of the volatile carbonyls, and also from the other point of view the regularities observed among the volatile carbonyls confirms a wider potency of the influence of the E.A.N. than had been suspected from the composition of the simpler compounds of the transition elements. Elements within three places of the inert gases are conceded to acquire the electron structure of the inert gases, but the elements in the middle parts of the long periods have been generally conceded to acquire polar valence through a transfer of electrons into incomplete inner layers, leaving generally two or three electrons only in the valence layer.

Complete loss of these valence electrons has gen-

erally been regarded as the explanation of polar valence in such ions as are commonly formulated as  $\text{Fe}^{++}$ ,  $\text{Fe}^{+++}$ ,  $\text{Mn}^{++}$ ,  $\text{Cr}^{+++}$ ,  $\text{Co}^{++}$ ,  $\text{Ni}^{++}$ , etc., and little evidence has been apparent that the effective atomic number exerts any influence in forming compounds of the transition elements.

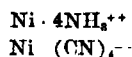
But with the evidence of the volatile carbonyls and in view of the fact that carbon monoxide and nitric oxide enter the composition of many complex ions it seemed fitting to reexamine the list of complex ions to see if any influence of the E.A.N. could be traced. I believe that the evidence presented in Tables 5-9 will be quite convincing that there is such an influence.

There is a good deal of similarity between volatility and ionization. In volatile substances the field is self-contained within the molecule and the lack of external field accounts for the lack of cohesion between the molecules. With charged ions there is a great external field and there can be no chance of volatility outside the confines of the solution. But within the solution ions may exist when the electrostatic field is uniform, that is, when the charge is symmetrically distributed over the ion.

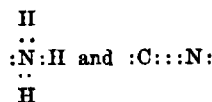
Nickel atoms are usually pictured as forming ions through the loss of electrons:



The fact that bare  $\text{Ni}^{++}$  ions do not exist in more than the most infinitesimal concentrations, if at all, does not seem to bother the authors of text-books. The only excuse for writing  $\text{Ni}^{++}$ —and it is seldom apparent that the authors realize any need for an excuse—is that the number  $n$  of water molecules in the hydrate  $\text{Ni} \cdot n\text{H}_2\text{O}^{++}$  is unknown. It ought to be apparent from the knowledge of complex ions such as



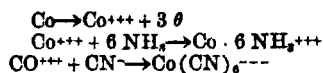
that the ion  $\text{Ni}^{++}$  can not exist in water without surrounding itself with coordinating  $\text{H}_2\text{O}$  molecules. If the coordinating groups



are joined to the nickelous ion by means of the lone pairs it is obvious that each addendum adds 2 to the E.A.N. which thus becomes

$$28 - 2 + 8 = 34.$$

Obviously, the coordinating shell of eight electrons between the positive kernel of the Ni atom and the positive kernels of the N or C atoms imparts a certain stability to the structure. These complex nickelous ions are moderately stable but let us compare their stability with that of the cobaltic complex ions.



These cobaltic complexes are extraordinarily stable and once formed they are broken down only by very strenuous chemical treatment. In them the E.A.N. of cobalt is

$$27 - 3 + 12 = 36.$$

It might of course be accidental, and due to some other cause, that in these two cases the complex with the E.A.N. of krypton is much more stable, but let us proceed to see how generally such a relation holds.

#### COMPLEXES OF IRON

Of the two cyanide complexes of iron the ferricyanide (E.A.N. = 37) is the less stable and it tends to go over to the ferrocyanide (E.A.N. 36). In Table 5 are listed several of the substituted cyanide complexes of iron where M represents a univalent alkali metal.

TABLE 5  
COMPLEXES OF IRON

$\text{M}_2[\text{Fe}(\text{CN})_6]$	$26 - 2 + 12$	36
$\text{M}_2[\text{Fe}(\text{CN})_5]$	$26 - 3 + 12$	35
$\text{M}_2[\text{Fe}(\text{CN})_5\text{NO}]$	$26 - 2 + 12$	36
$\text{M}_2[\text{Fe}(\text{CN})_5\text{NH}_3]$	$26 - 2 + 12$	36
$\text{M}_2[\text{Fe}(\text{CN})_5\text{NO}]$	$26 - 1 + 12$	37
$\text{M}_2[\text{Fe}(\text{CO})_4]$	$26 + 2 + 8$	36

Treatment of either the ferrocyanide or ferricyanide with hot concentrated nitric acid yields the fairly stable nitro prusside complex, E.A.N. 36, and sodium nitro prusside can be crystallized from the solution. If this complex is treated with ammonia, the nitric oxide is substituted by ammonia  $\text{M}_2[\text{Fe}(\text{CN})_5\text{NO}] + 3\text{NH}_3 + \text{H}_2\text{O} \rightarrow \text{NH}_4\text{M}_2[\text{Fe}(\text{CN})_5\text{NH}_3] + \text{NH}_4\text{NO}_2$  and the E.A.N. in the new complex is still 36.

But if the ammonia-substituted complex is treated with NO in acidified solution the freely running reaction  $\text{HC}_2\text{H}_3\text{O}_2 + \text{M}_3[\text{Fe}(\text{CN})_5\text{NH}_3] + \text{NO} \rightarrow \text{M}_3[\text{Fe}(\text{CN})_5\text{NO}] + \text{NH}_4\text{C}_2\text{H}_3\text{O}_2$  gives rise to a different nitro prusside complex in which the E.A.N. is 37. But this complex is very unstable and it spontaneously changes into the ordinary nitro prusside within a short time.

#### COMPLEXES OF COBALT

Contrasted with the cyanide complexes of iron, the cobaltocyanide complex (E.A.N. 37) is the unstable compound of cobalt and this has a very strong tendency to go over into the cobalticyanide.

TABLE 6  
COMPLEXES OF COBALT

$\text{M}_2[\text{Co}(\text{CN})_6]$	$27 - 3 + 12$	36
$\text{M}_2[\text{Co}(\text{CN})_5]$	$27 - 2 + 12$	37
$\text{M}_2[\text{Co}(\text{CN})_5\text{CO}]$	$27 - 2 + 12$	37
$[\text{Co}(\text{NH}_3)_6]\text{X}_3$	$27 - 3 + 12$	36
$\text{M}[\text{Co}(\text{CO})_4]$	$27 + 1 + 8$	36

In the preparation of the carbonyl substituted double cyanide Manchot and Gall took extreme precaution to prevent possible oxidation to the cobaltic state and hence no chance was given to form the compound  $M_2[Co(CN)_5CO]$  in which the E.A.N. would be 36. In our own laboratories all attempts to prepare either this complex or  $M[Co(CN)_5NO]$  have failed, but invariably some other compounds with E.A.N. of 36 have appeared, either  $M[Co(CO)_4]$  or  $M_3[Co(CN)_6]$ .

#### COMPLEXES OF NICKEL

In all the complex cyanides of nickel the coordination number is four. No complex compound of the formula  $M_2[Ni(CN)_6]$  in which the E.A.N. would be 36 has been prepared and it is hard to see why such a compound would not be stable.

TABLE 7  
COMPLEXES OF NICKEL

$M_2[Ni(CN)_4]$	28 - 2 + 8	34
$M_4[Ni(CN)_4]^*$	28 + 0 + 8	36
$M_3[Ni(CN)_5NO]$	28 + 0 + 8	36
$Ni(CO)_4$		36

\* W. M. Burgess: private advices.

The complex cyanide  $M_2Ni(CN)_4$  obtained by treating salts of divalent nickel with excess alkali cyanide is not particularly stable. When the coordination number is four it is only possible for the nickel to show the E.A.N. of krypton when the nickel has the unexpected polar valence of zero. And we find that the complexes  $[Ni(CN)_4]^{--}$  and  $[Ni(CN)_5NO]^{--}$  exist as well as nickel carbonyl in which the polar valence is zero.

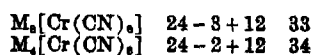
TABLE 8  
COMPLEXES OF MANGANESE

$M_2[Mn(CN)_6]$	25 - 3 + 12	34
$M_4[Mn(CN)_6]$	25 - 2 + 12	35
$M_3[Mn(CN)_5]$	25 - 1 + 12	36
$M_2[Mn(CN)_5NO]$	25 - 1 + 12	36

The ordinary double cyanides obtained from salts of divalent and trivalent manganese and excess of alkali cyanide are not particularly stable, but the trend towards the E.A.N. of 36 is shown in the formation of complexes of monovalent manganese  $[Mn(CN)_6]^{--}$  and  $[Mn(CN)_5NO]^{--}$ . The E.A.N. influence must indeed be compelling to allow the existence of a complex ion with five charges.

#### COMPLEXES OF CHROMIUM

The only complex cyanides of chromium on record are those formed from the common salts of divalent and trivalent chromium and excess of alkali cyanide



and neither of these are particularly stable.

With the coordination number of six in order to acquire the E.A.N. of krypton, chromium would have to show a polar valence of zero as it does in the hexacarbonyl, and we might look for the complex compounds  $M_6[Cr(CN)_6]$ ,  $M_5[Cr(CN)_5CO]$ ,  $M_4[Cr(CN)_5NO]$ . With coordination number four we might look for  $[Cr(NO)_4]$  and  $M_4[Cr(CO)_4]$  and with coordination number eight we might look for  $M_4[Cr(CN)_8]$ . As a matter of fact, molybdenum and tungsten do show the E.A.N. of xenon and radon, respectively, in the octacyanide complexes.

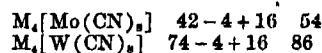


TABLE 9  
COMPLEXES OF THE PLATINUM METALS

$M_4[Ru(CN)_6]$	44 - 2 + 12	54	Xe
$M_2[Ru(CN)_5NO]$	44 - 2 + 12	54	Xe
$M_3[RuCl_5NO]$	44 - 2 + 12	54	Xe
$M_2Rh(CN)_6$	45 - 3 + 12	54	Xe
$M_2[PdCl_4]$	46 - 4 + 12	54	Xe
$M_2[Pd(CN)_4]$	46 - 2 + 8	52	
$M_2[OsCl_4]$	76 - 4 + 12	84	
$M_2[OsCl_5]$	76 - 3 + 12	85	
$M_2[OsCl_5NO]$	76 - 2 + 12	86	Rn
$M_4[Os(CN)_6]$	76 - 2 + 12	86	Rn
$M_2[Ir(CN)_6]$	77 - 3 + 12	86	Rn
$M_2[PtCl_4]$	78 - 4 + 12	86	Rn
$M_2[PtCl_5(CN)_4]$	78 - 4 + 12	86	Rn
$M_2[Pt(CN)_4]$	78 - 2 + 8	84	

Table 9 presents a representative although not a complete list of the complexes of the platinum metals, and it should be remembered that the discovery of these compounds was essentially accidental, and certainly not as the result of a deliberate attempt to confirm the E.A.N. doctrine. Again we find that the stabilizing effect of a coordinate layer of eight or twelve allows some complexes to exist with E.A.N. not that of an inert gas. But in the main, the tendency to acquire the E.A.N. of xenon and radon is very obvious and is controlling in every instance cited in which nitric oxide enters the complex.

Recent advices from W. C. Fernelius state that he has succeeded in preparing a compound of palladium,  $K_4Pd(CN)_4$ , in which palladium has the valence of zero and the E.A.N. of xenon. Fernelius applied the method by which Burgess obtained the similar nickel compound  $K_4Ni(CN)_4$ . A solution of potassium palladocyanide,  $K_2Pd(CN)_4$ , in liquid ammonia is treated with a solution of potassium in liquid ammonia. A sharp end point is reached both with the nickel and the palladium compound when the deep blue color of the potassium solution ceases to be discharged. It may be noted that when Burgess analyzed his preparation he was so astonished to find the composition  $K_4Ni(CN)_4$  that he felt compelled to recheck his analyses before he could believe the existence of a compound in which nickel had a valence of zero. Comparison of this compound with the carbonyls, however, helped greatly to relieve the disbelief. On

the other hand, Fernelius on the basis of Burgess' discovery hoped to prepare  $K_4[Pd(CN)_4]$  and his success in doing so must be considered as a strong support of the potency of the effective atomic number.

### SUMMARY

When the metal carbonyls were first discovered, their properties were startling because they seemed to violate nearly all the previously recognized generalizations of chemistry. Even to-day the existence of the carbonyls is not particularly emphasized in elementary courses of chemistry because it is rather hard to reconcile them with the first presentations of the generalizations of chemistry. Nevertheless, as the student progresses deeper into the knowledge of chemistry it becomes desirable to include the knowledge of the carbonyls both because they become more comprehensible when viewed in the light of Werner's system of coordination and because they themselves contribute to the comprehension of the Werner theory.

As long ago as 1931, Reiff in his discussion of cobalt nitrosyl carbonyl recognized the correlation between the effective atomic number and the volatility of carbonyls. A more recent study of *charged* Werner coordination complexes, that is, of complex ions, has shown a similar role of the effective atomic number.

We are standing on fairly firm ground when we point out the correlation between E.A.N. and the volatility of the carbonyl complexes and the existence of complex ions. Be it noted that we have made no postulates as to the arrangement of the electrons in quantum levels. In the inert gases the outer principal quantum group is supposed always to contain eight electrons. In the carbonyls and other Werner complexes there is no compelling reason to suppose that the electrons in the coordinating layer, be this layer of eight, ten, twelve or sixteen electrons, are not all at the same energy level.

Although we have confined our discussion almost exclusively to the property of volatility, the carbonyls are very interesting from the standpoint of several other properties, for example, magnetic susceptibility and dielectric constant. Enthusiasts in the interpretation of such properties try to draw conclusions as to the condition of the electrons, sometimes they become

so dogmatic as to seem really to believe in the actual existence of the condition they postulate.

As Professor Smith said, "Theories come and theories go, but facts live on forever." The facts of chemistry are so multitudinous that we would be utterly helpless to use them had we not means of correlating them. Any postulates which reach beneath the surface of the directly observable to give a mechanism to correlate the facts are helpful. But a scientist without a sense of humor is pretty hopeless. Who in his right mind can regard as other than absurd the idea that an electron pair can simultaneously occupy positions in two atom shells to make up the supposedly necessary number in each atom? In fact, is not the electron itself a pretty ridiculous figment of the imagination? To be sure, we recognize the electron as a discrete entity with certain very definite properties, but in the light of comparison with any mechanism within our comprehension is not the electron perfectly impossible? By all means let us use a postulate which allows us to make a useful classification of facts, but never let us lose the sense to see how utterly ridiculous the postulate will look to one who has not like ourselves grown attached to it.

We do not expect ever to discover the ultimate reason for things, but we do expect ever to make progress in correlating and classifying the facts which we have already discovered and shall continue to discover. Dogmatic belief in ridiculous postulates retards this progress.

Since the foregoing manuscript was submitted the paper by Hieber and Lagally, *Zeit. Allgem. Anorg. Chem.*, 245: 321, November, 1940, has come to our attention in which the preparation of carbonyls of iridium by Hieber's high pressure technique is described. Non-volatile  $[Ir(CO)_3]_n$ , corresponding to the cobalt tricarbonyl, is the principal product, but there is evidence that compounds corresponding to  $[Co(CO)_4]_2$  and the volatile  $HCo(CO)_4$  are also formed. A very volatile compound containing iridium is in evidence whenever traces of water or hydrogen are present in the autoclave, and although this compound can not be isolated for analysis it presumably is the carbonyl hydride  $HIr(CO)_4$  in which iridium has the E.A.N. (86) of radon.

## OBITUARY

### WILLIAM FRANCIS GANONG 1864-1941

THE death of William Francis Ganong removes from the field of botany one of its outstanding leaders during the past fifty years. Dr. Ganong, a Canadian of loyalist descent, was born in St. John, New Bruns-

wick, on February 19, 1864, the son of the late James H. and Susan E. Ganong. He was graduated from the University of New Brunswick with the degree of B.A. in 1884 and with that of M.A. in 1886, and in 1887 received his A.B. from Harvard. He obtained his Ph.D. from Munich in 1894, and in 1898 and 1920

was granted the honorary degrees of Ph.D. and LL.D., respectively, by the University of New Brunswick.

Except for a few years of teaching at Harvard his entire academic life was spent at Smith College, Northampton, Massachusetts. Coming in 1894 as the first professor of botany and director of the Botanic Gardens, he built up the department of which he served as head or chairman until his retirement in 1932, when he was appointed professor emeritus. During his service here, the Botanic Gardens were established, and the Lyman Plant House and Burton Hall, the present biology building, were erected. For many years he gave generously of his time to administrative matters.

A man of broad interests, he published in the fields of morphology and ecology, although his primary interest was in physiology. Here he was widely known for his research and the apparatus which he developed for student use. But to those who knew him best he will be remembered primarily as a teacher. Possessed of an enthusiasm which was easily passed on to his students he taught both by precept and example, instilling into their minds the love of honest, thorough work and regard for the truth. His interest in botanical education led to the publication of *The Teaching Botanist*, one of the earliest books in this field now growing in importance. Other books of his were "A Laboratory Course in Plant Physiology," "The Living Plant" and "A Textbook of Botany for Colleges."

He had served as secretary for the Society of Morphology and Physiology and as president of the Botanical Society of America. He was also a corresponding member of the Royal Society of Canada, and in December, 1940, was awarded the Charles Reid Barnes Life Membership by the American Society of Plant Physiologists.

In addition to his work as a botanist he was recognized as an authority on the natural history of New Brunswick. From his early days he had followed this subject with great enthusiasm and during this time had assembled an unusually valuable collection of books, papers, maps and other documents bearing upon New Brunswick history. This collection has been presented to the New Brunswick Museum and has been described as "undoubtedly the most valuable that has yet been offered to the Museum." Of him and his work Dr. J. Clarence Webster, C.M.G., of Schenectady has said: "As a worker Dr. Ganong has been characterized by great honesty and accuracy. Regarding New Brunswick he was the greatest authority who ever lived on the subject; its natural history, its settlement, its geology, its Indian life and its general development. As an authority on the cartography of the entire eastern coast of North America, he and Mr.

Prowse of Winnipeg are two of the greatest." Dr. Ganong translated and edited Denys' "Natural History of Acadia," LeClerq's "New Relation of Gaspesia" and Champlain's "Voyages to Acadia and New England."

Dr. Ganong was married in 1888 to Jean Murray Carman, of Fredericton, New Brunswick, the sister of Bliss Carman, the well-known Canadian poet. She died in 1920 and he later married Anna Hobbet, of Eagle Grove, Iowa, who with two children, William Francis, Jr., a freshman at Harvard, and Ann, survive him. His death occurred on September 7, at St. John, New Brunswick, after a long illness.

FRANCES GRACE SMITH  
HELEN A. CHOATE

SMITH COLLEGE

## DEATHS AND MEMORIALS

DR. FRANK BURR MALLORY, since his retirement in 1932 professor emeritus of pathology in the Harvard Medical School, died on September 27 at the age of seventy-eight years. Dr. Mallory joined the staff of the school as assistant in histology in 1890. He was pathologist of the Boston City Hospital from 1908 to 1932, when he became consulting pathologist.

DR. CARROLL MASON SPARROW, professor of physics in the University of Virginia, died suddenly at his home on the evening of August 30. He was sixty-one years old. He had served on the faculty for thirty years.

DR. THOMAS HARDY TALIAFERRO, professor of mathematics and dean of the faculty of the University of Maryland, died on September 25 at the age of seventy years.

DR. ANDREW RICHARD BLISS, JR., professor of pharmacology and dean of the School of Pharmacy of Howard College, Birmingham, Ala., died on August 12 in his fifty-third year.

DR. ELMER SAMUEL IMES, professor and head of the department of physics at Fisk University, Nashville, Tenn., died on September 12 at the age of fifty-eight years.

A COPY of the Congressional resolution designating February 11 as "Thomas A. Edison Day" and the pen with which it was signed by President Roosevelt were presented on September 25 to Mrs. Mina Edison Hughes, widow of the inventor, at a dinner, attended by three hundred and fifty persons, which had been arranged by the Chamber of Commerce and Civics of the Oranges and Maplewood, N. J.

## SCIENTIFIC EVENTS

BUHL FOUNDATION GRANT TO THE  
UNIVERSITY OF PITTSBURGH

THE Buhl Foundation of Pittsburgh, Pa., has announced the renewal and enlargement of a grant to the University of Pittsburgh in support of graduate study and a coordinated research program in the departments of chemistry, physics and biology. A fund of \$40,000 per year, primarily for research fellowships and supplies, will be available through a five-year period, three fourths of the fund being contributed by the foundation and one fourth by the university. The grant will be administered by a Research Committee consisting of Provost Rufus H. Fitzgerald, Dean Stanton C. Crawford, Dean William T. Root, Dean William S. McEllroy, Dr. Leonard H. Cretcher, Dr. Edward U. Condon, Dr. Davenport Hooker, Dr. Peter Gray, Dr. Elmer Hutchisson and Dr. C. G. King, *chairman*. In the division of biochemistry, major emphasis will be placed upon studies in nutrition, tissue respiration and the chemistry of fats. Specific heats, heats of combustion and heats of dilution will be studied in relation to the molecular structure of sugars, fats and amino acids in the division of physical chemistry. Research involving the use of radioactive tracer elements and spectroscopy will be carried out in cooperation with the department of physics, where additional work will be supported in the field of atomic physics (where a cyclotron is under construction) and in the use of the electron microscope. Three research fellows in the department of biology will study basic problems in embryology, two phases of which (blood formation and the effects of copper) are closely related to work under way in the department of chemistry.

THE BERMUDA BIOLOGICAL STATION  
FOR RESEARCH

THE buildings and grounds of the Bermuda Biological Station have been leased to the U. S. Government for a period of one year, with privilege of renewal, as a temporary hospital for the construction workers and personnel of the U. S. Base in Bermuda.

Books, scientific equipment and supplies have been placed in storage in St. Georges. The activities of the station, however, will not be suspended since the government aquarium at Flatts has made available its small laboratory and will assist in collecting material and otherwise aiding those who wish to carry on investigations in Bermuda. In fact, a few workers have already made use of these facilities. The aquarium has also offered a portion of its property adjacent to the new museum as a site for a temporary building to accommodate books and for additional laboratory space. At a recent meeting of the trustees of the

station it was voted to erect such a building, and plans are now being drawn up.

Special rates to Bermuda for scientific workers are available from the Alcoa Line, which has weekly sailings from New York. Living accommodations are available at Flatts. Investigators who have problems that they may wish to work on in Bermuda should communicate with the Secretary—J. H. Welsh, Biological Laboratories, Harvard University, Cambridge, Mass.

THE HARVARD SCHOOL OF DENTAL  
MEDICINE

DR. LEROY M. S. MINER, dean of the Harvard Dental School, has announced the opening on September 23 of the new "Harvard School of Dental Medicine," with nine carefully selected students from widely separated parts of the country composing the first-year class. The new school was made possible by an endowment of \$1,500,000, mainly derived from gifts of the Carnegie, Rockefeller and Markle Foundations. For the present the maximum number of students to be accepted under the plan of instruction in any one class is set at fifteen. The Harvard Dental School will continue its present course for three years more, until members of the present second-year class are graduated. Dean Miner has made the following statement:

The opening of the new school marks the beginning of an important experiment in American dental education. The trend in dental training in the last twenty-five years has been towards increased biological study of the causes of diseases of the teeth and closer cooperation with medicine. Students in the new school will be occupied for the majority of five calendar years in a combined course of dentistry and medicine, and at the end of that time successful candidates will receive both the M.D. and D.M.D. degrees. The student will receive the basic training in medicine required of all physicians, without sacrificing the essential training in the restorative and reparative techniques of dentistry which are all important. In addition, by the combined work which he will perform, we hope he will be well equipped to carry on further study on the causes of dental disease and its prevention.

The faculty of the new school will be composed, in addition to Dean Burwell, of the Medical School, who is chairman of the Committee on Instruction, of thirteen men who are now serving the Harvard Dental School with distinction, and the following three men who have been called from the outside to work in the development of the new program. These men are: Joseph W. Ferrebee, M.D., associate professor of dental medicine, formerly of the College of Physicians and Surgeons, New York; Dr. Martin L. Deakins, formerly of the University of Rochester School of Medicine and Dentistry, and Charles M. Waldo, D.D.S., assistant professor of orthodontics, formerly of the University of Michigan School of Dentistry.

The new laboratory of dental medicine, directed by Dr. Joseph W. Ferrebee, is an important step forward in the field of investigation in problems incident to dental medicine, and will be integrated usefully with the several leading hospitals associated with the professional education at Harvard. Furthermore, carrying out on a larger scale activities already instituted at the Harvard Dental School, Dr. Paul E. Boyle is in charge of the laboratory of oral pathology, closely associated physically and in function with the department of pathology at the Harvard Medical School, directed by Dr. S. B. Wolbach. With these two laboratories as centers, opportunities will be provided for research workers, and for teachers, and, also, students in clinical dentistry will be afforded an insight into fundamental dental problems not heretofore possible.

### THE SCIENCE CLUBS OF AMERICA

SCIENCE SERVICE reports in a press bulletin that it has joined the American Institute of the City of New York, an institution chartered in 1828, in developing the science clubs movement. Science Service will sponsor the Science Clubs of America as a national science club movement. The American Institute will continue to foster junior science clubs and related activities in the metropolitan area of New York City and in the State of New York.

An advisory committee on Science Clubs of America, representing jointly the American Institute and Science Service, is being formed.

In developing this broad science clubs movement, there will be enlisted the enthusiasm, support and participation of newspapers, museums, schools and other scientific and educational institutions, including professional scientific societies and industrial organizations.

In various regions there will be developed additional "science centers," which, on a regional or local basis, will further coordinate and aid the science clubs in their vicinities as a supplement to the national organization.

The new plan has been announced by Dr. H. C. Parmelee, president of the American Institute, and Watson Davis, director of Science Service, in simultaneous communications to sponsors of existing science clubs. The statement made by Dr. Parmelee reads:

About 14 years ago, when The American Institute was rounding out a hundred years of service to American industry, the leaders of this century-old organization launched a wholly modern activity that was, nevertheless, in harmony with the oldest and finest traditions of the institute. They started a program to encourage and develop an interest in science among the youth of the metropolitan area of New York City. That movement shortly resulted in the organization of about two hundred Junior Science Clubs, a Junior Science Fair and a Junior Science Congress.

Attracted by the success of the local movement, and believing firmly in the value of scientific knowledge and training among the youth of the country, the Westinghouse Electric and Manufacturing Company placed at the disposal of the institute means for extending the Junior Science Club movement and related activities throughout the United States. The program met with unparalleled success and resulted in the organization of over eight hundred clubs. Indeed the movement expanded beyond the present capacity of the institute to service all the clubs and foster their related activities.

At this juncture Science Service, an institution for the popularization of science, with headquarters in Washington, D. C., and excellent national contacts and affiliations, proposed to the institute a division of responsibility in the Junior Science Program.

Speaking for The American Institute, I commend the joint plan as a step in the achievement of common objectives; and I believe that both working together can accomplish more than each separately.

Mr. Davis said:

The work that you are doing in inspiring and directing a science club is one of the great services to American youth. In order that we may have a continuance of our democratic civilization based on scientific principles, it is essential that such endeavors as yours shall be given the fullest possible support and that other leaders of youth follow your example.

It is in this spirit that Science Service, the institution for the popularization of science, joins its forces with those of The American Institute in continuing, extending and developing the science club movement.

### THE AMERICAN CHEMICAL SOCIETY

AN increase in the membership of the American Chemical Society during the past year to a total of 28,525 is reported by Dr. Charles L. Parsons, secretary of the society.

A new local section, to be known as the Binghamton Section with headquarters at Binghamton, N. Y., has been organized, bringing the number of sections throughout the country to ninety-four. The next semi-annual meeting will be held in Memphis, Tenn., in April, 1942.

Walter A. Schmidt, of the Western Precipitation Company, Los Angeles, Calif., has been named to the Council Policy Committee for a term of three years beginning January, 1942.

Associate editors to four of the society's publications have been chosen as follows:

*Journal of American Chemical Society*: Professor Frederick G. Keyes, of the Massachusetts Institute of Technology; Professor N. Howell Furman, of Princeton University; Dr. Paul H. Emmett, of the Johns Hopkins University.

**Technological Autographs:** Thomas Chilton, of E. I. du Pont de Nemours and Company, Wilmington, Del.; Mr. Schmidt; Dr. E. R. Weidlein, director of the Mellon Institute of Industrial Research, Pittsburgh, Pa.

**Journal of Physical Chemistry:** Dr. Leason H. Adams, director of the Geophysical Laboratory, Carnegie Institution of Washington; Professor B. S. Livingston, of the University of Minnesota.

**Chemical Reviews:** Norman D. Scott, of E. I. du Pont de Nemours and Company, Sanborn, N. Y.; Professor Warren C. Johnson, of the University of Chicago.

Dr. B. L. Clarke, of the Bell Telephone Laboratories, New York City, and Thomas R. Cunningham, of the Union Carbide and Carbon Company, Niagara Falls, N. Y., have been named to the advisory board of the analytical edition of *Industrial and Engineering Chemistry*.

### THE SCIENTIFIC CONFERENCE IN LONDON

THE International Conference arranged by the British Association for the Advancement of Science opened in London on September 26, with a message from the Prime Minister, and there was read later a message from King George VI. John G. Winant, United States Ambassador, presided over the first session, and later sessions were presided over by the Soviet Ambassador, Ivan Maisky, and Dr. Eduard Beneš, president of the Czech Government in exile.

The meeting was opened by Sir Richard Gregory, president of the British Association, editor of *Nature* from 1919 to 1939, who at the concluding session presented a seven-point charter of scientific principles which was adopted. As cabled to *The New York Times*, it reads:

(1) Liberty to learn, the opportunity to teach and the power to understand are necessary for the extension of knowledge and we, as men of science, maintain that they can not be sacrificed without the degradation of human life.

(2) Communities depend for their existence, survival, knowledge and advancement on the knowledge of themselves and of the properties of things in the world around them.

(3) All nations and all classes of society have contributed to the knowledge and utilization of natural resources and to the understanding of the influence they exercise on human development.

(4) The basic principles of science depend on independence combined with cooperation and are influenced by the progressive needs of humanity.

(5) Men of science are among the trustees of each generation's inheritance of natural knowledge. They are bound, therefore, to foster and increase that heritage by faithful guardianship and service to high ideals.

(6) All groups of scientific workers are united in the fellowship of the commonwealth of science which has the

world for its province and the discovery of truth as the highest aim.

(7) The pursuit of scientific inquiry demands complete intellectual freedom and unrestricted international exchange of knowledge and can only flourish through the unfettered development of civilized life.

### HONORARY DEGREES CONFERRED AT THE FIFTIETH ANNIVERSARY OF THE UNIVERSITY OF CHICAGO

THE scientific papers in the symposia on "New Frontiers in Education and Research," given on the occasion of the celebration of the fiftieth anniversary of the University of Chicago held in cooperation with the American Association for the Advancement of Science, were followed by a convocation on September 29 at which honorary degrees were conferred. Those in science, according to the advance announcement, were as follows:

Charles E. Allen, professor of botany, the University of Wisconsin, discoverer of sex chromosomes in plants.

Charles H. Best, professor and chairman of the physiology department at the University of Toronto, co-discoverer of insulin.

George D. Birkhoff, professor of mathematics at Harvard University, leading contributor to the fundamentals of dynamics.

Reginald A. Daly, professor of geology at Harvard University, authority on the origin of rocks and glaciers.

Edward A. Doisy, professor of biological chemistry at St. Louis University, noted for his identification of pure female hormone and two types of vitamin K.

Ernest W. Goodpasture, professor of pathology at Vanderbilt University, inventor of new methods of studying disease viruses.

Evarts A. Graham, professor of surgery at Washington University, St. Louis, nationally recognized for his contributions to the technique of modern surgery.

Libbie Hyman, member of the American Museum of Natural History in New York, noted for her contributions to the life processes of animals and internationally recognized as an authority on invertebrate zoology.

Herbert S. Jennings, professor emeritus of zoology at the Johns Hopkins University, authority on the behavior of simple forms of animal and plant life.

Karl S. Lashley, professor of neuropsychology at Harvard University, famous for his investigations of brain mechanisms.

Ernest O. Lawrence, professor of physics at the University of California, Nobel Laureate, inventor of the cyclotron, making possible sub-atomic chemistry.

Robert H. Lowie, professor of anthropology at the University of California, authority on the American Indian.

Robert A. Millikan, chairman of the executive council of the California Institute of Technology, Nobel Laureate, measurer of the electron and authority on cosmic rays.

Carlos A. Monge, dean and professor of medicine at the University of San Marcos, Lima, Peru, discoverer of

"Monge's Disease," characteristic of the inhabitants of high altitudes.

Linus C. Pauling, professor and chairman of the department of chemistry at the California Institute of Technology, authority on forces between atoms in molecules and crystals.

Thomas M. Rivers, director of the Hospital of the Rockefeller Institute, international authority on the viruses of human and animal diseases.

Henry N. Russell, director of the Princeton Astronomical Observatory, discoverer of giant and dwarf stars and pioneer in the study of the evolution of the universe.

Florence B. Seibert, associate professor of physiological chemistry at the Henry Phipps Institute, Philadelphia, authority on the chemistry of tuberculin.

Donald D. Van Slyke, member of the Rockefeller Institute, inventor of new methods of chemical analysis used in the treatment of disease.

Oswald Veblen, professor of mathematics at Princeton University, internationally known for his contributions to geometry.

Robert R. Williams, director of chemistry at the Bell Telephone Laboratories in New York, discoverer of vitamin B<sub>1</sub>.

## SCIENTIFIC NOTES AND NEWS

LEHIGH UNIVERSITY has conferred the honorary degree of doctor of laws on Dr. R. G. D. Richardson, professor of mathematics and dean of the Graduate School of Brown University.

At the fiftieth anniversary meeting of the Wisconsin Library Association, which was held at Madison on September 26, 27 and 28, Dr. Edward A. Birge, formerly professor of zoology, now president emeritus of the university, was the guest of honor. Dr. Birge is one of the founders of the association. Special tributes to librarians prominent in the history of the association were made during the convention.

DR. JOHN H. LAWRENCE, professor of medicine at the University of California, was presented on September 23 with the medal of the American Roentgen Ray Society at the recent meeting in Cincinnati.

THE Daniel Guggenheim Medal for notable achievements in the advancement of aeronautics has been awarded to Juan T. Trippe, president of the Pan American Airways System, "for the development and successful operation of oceanic air transport." The medal will be presented on January 27 at a dinner to be given by the Institute of Aeronautical Sciences.

THE Theobald Smith Award in the medical sciences of the American Association for the Advancement of Science was presented on September 22 at the Chicago meeting to Dr. Herald R. Cox, of the Rocky Mountain Laboratory at Hamilton, Mont., of the U. S. Health Service. The presentation was made by Dr. Irving Langmuir, president of the association. Dr. Cox spoke on the "Cultivation of *Rickettsiae* of the Rocky Mountain Spotted Fever, Typhus and Q Fever Groups in the Embryonic Tissues of Developing Chicks."

SAMUEL STACEY, head keeper at the New York Zoological Park, has retired after serving for thirty-seven years with the New York Zoological Society. The title of honorary head keeper of birds has been created for him.

DR. RALPH H. HEEREN has resigned as assistant professor of hygiene and preventive medicine at the State University of Iowa College of Medicine, Iowa City, to accept a similar position at the School of Medicine of Tulane University of Louisiana, at New Orleans.

PROFESSOR BENEDICTO MONTENEGRO, the Brazilian surgeon, has been appointed director of the faculty of medicine of the University of São Paulo.

JAMES RUSSELL OYLER has been appointed General Mills, Inc., research fellow in the department of agricultural and biological chemistry of the Pennsylvania State College. He will work with Dr. H. O. Tribold on the chemical and physical characteristics of certain food fats.

DR. CARL C. LINDEGREN, who has a year's leave of absence from the University of Southern California, is studying the genetics of yeast at Washington University, St. Louis. The work is supported by a grant from Anheuser Busch, Incorporated.

DR. AUSTIN M. PATTERSON, who retired from the professorship of chemistry at Antioch College last June, has joined the staff of Engineering, Science and Management Defense Training of the U. S. Office of Education, as senior specialist in chemical education.

DR. JEROME C. HUNSAKER, head of the department of mechanical engineering at the Massachusetts Institute of Technology, has been appointed a member of the United States Commission which will prepare proposals for the permanent American Aeronautical Commission, created by the Inter-American Technical Aviation Conference at Lima, Peru, in 1937. The permanent commission will attempt to unify and codify the international and national air laws of the American republics.

DR. KARL L. BOWMAN, director of the division of psychiatry at Bellevue Hospital and professor of psychiatry at New York University College of Medicine, has been appointed director of the new Langley

Porter Clinic, a neuropsychiatric unit of the State Department of Institutions, under the direction of the Medical School of the University of California, San Francisco. He will begin his new work at the clinic about November 1. The building, erected at a cost of \$500,000, is nearing completion, the cornerstone having been laid on April 5.

DR. RAYMOND L. DITMARS, curator of reptiles and insects at the New York Zoological Park, arrived in New York on September 20 after a visit to Trinidad, bringing with him 1,500 specimens.

SIR HAROLD DELF GILLIES, consultant adviser to the British Ministry of Health, now in charge of special units for the repair of facial injuries in the London area, will be a guest of the American Academy of Ophthalmology and Otolaryngology at the meeting in Chicago, which will be held from October 19 to 23. Sir Harold will make an address at a special defense program presented by the academy on the evening of October 20. The other speakers will be Dr. Irvin Abell, Louisville, Ky., past president of the American Medical Association and now chairman of the committee of the association on medical preparedness as well as chairman of the health and medical committee of the Federal Security Agency; Colonel Louis H. Bauer, Hempstead, N. Y., an authority on aviation medicine and now a member of the committee of the New York State Medical Society on medical preparedness, and Dr. Burt R. Shurly, Detroit, past president of the academy and chairman of its special committee on national defense.

DR. R. D. GILLESPIE, who is now chief psychiatrist for the British Royal Air Force, will visit the United States at the request of the Salmon Committee on Psychiatry and Mental Hygiene of the New York Academy of Medicine. He will deliver the Salmon Memorial Lectures at the New York Academy building on November 17, 18 and 19. He is expected to speak on "Psychoneuroses from the Standpoint of War Experience." The New York lectures will be followed by addresses to be given before the Chicago Neurological Society, the Chicago Institute of Medicine and the Illinois Psychiatric Society in Chicago. Dates for these lectures as well as for lectures in Toronto, Ontario, and San Francisco, Calif., will be announced later.

PROFESSOR WILLIAM LLOYD EVANS, of the Ohio State University, president of the American Chemical Society, spoke before the Ames Section at the Iowa State College on September 24. His topic was "The Chemical Behavior of Reducing Sugars in Alkaline Solution."

DR. ERNEST O. LAWRENCE, professor of physics and director of the Radiation Laboratory of the Uni-

versity of California at Berkeley, will deliver on October 5 the Lower Lecture of the Academy of Medicine at Cleveland. His subject will be "The Newer Physics in Medicine."

PRESIDENT NICHOLAS MURRAY BUTLER spoke at the opening exercises of Columbia University on September 24. He was followed by Dr. Douglas Johnson, professor of physiography and head of the department of geology, who gave the chief address. It was entitled "A Geographer Looks at the World." Dr. Harry S. Mustard, director of the DeLamar Institute of Public Health, was the principal speaker at the opening ceremonies at the College of Physicians and Surgeons.

THE first scientific lecture for 1941-42 of the College of Physicians of Philadelphia was the Alvarenga Prize Lecture, II. It was given on October 1 by Dr. John J. Bittner, assistant director of the Jackson Memorial Laboratory at Bar Harbor, who spoke on "The Influence of Foster Nursing on Experimental Breast Cancer."

IN the special article by E. B. Schoenbach, J. F. Enders and J. H. Mueller on "The Apparent Effect of Tyrothrycin on *Streptococcus Hemolyticus* in the Rhinopharynx of Carriers," SCIENCE, 1941, 94, 917, the word "tyrothricin" appearing in the title and in the text was misspelled as "tyrothrycin."

THE South West District meeting of the American Institute of Electrical Engineers will be held at St. Louis on October 8, 9 and 10.

THE one hundred and twenty-first annual meeting of the Swiss Society for the Investigation of Nature was held at Basle from September 6 to 8.

It is planned to hold an Inter-American Chemical Congress at Santiago, Chile, in January, 1942.

THE Société de Biologie de Montréal has announced the publication of a review which will be its official organ and which will contain the proceedings of the society as well as other reports of research. The membership of the society includes physicians, physiologists, biochemists, pharmacologists, bacteriologists, zoologists and others. The *Revue canadienne de Biologie*, which will be published in French, will appear under the auspices of the Université de Montréal. The society held its first meeting of the year on September 17 in the laboratory of physiology at the university.

THE Civil Service Commission announces an examination for radio mechanic-technicians at salaries ranging from \$1,440 to \$2,300 a year. Applications must be received by November 6. Applicants must show that they have had appropriate training or ex-

perience in one or more of the following: Paid experience in technical radio work such as radio repairman, operator or electrician; technical study in residence at a radio school; resident study including courses in radio in a school of engineering or technology; completion of an approved defense training course in any branch of radio work. An announcement by the commission states that the constantly increasing activities of the Navy Department call for many inspectors of aeronautical engineering materials. For many months the commission has had open an examination for inspectors covering several branches of aeronautical engineering materials. Provisions for using national defense training courses to meet the experience requirements have been liberalized. The positions pay from \$1,620 to \$2,600 a year, and the maximum age is 65 years.

THE New York Academy of Medicine announces the availability of the Louis Livingston Seamon Fund for the furtherance of research in bacteriology and sanitary science. Two thousand dollars is available for assignment in 1941. The fund will be expended only in grants in aid for investigation or for scholarships for research in bacteriology or sanitary science. Grants may be used for technical help, for aid in publishing original work or for the purchase of necessary books or apparatus. The fund is administered by a Committee of the academy under the following conditions and regulations: Communications should be received before November 1 by Dr. Wilson G. Smillie, chairman of the Louis Livingston Seamon Fund, 1300 York Avenue, New York City.

THE Louise A. Boyd Arctic Expedition of the National Bureau of Standards, which sailed from Washington on June 11, is expected to return about November 1. Both Miss Boyd and Captain Bob Bartlett, who commands the expedition schooner *Effie M. Morrissey*, are Arctic explorers of wide experience. They planned to observe the ionosphere characteristics as

determined by special radio measurements, geomagnetism, auroral manifestations and also to measure ultraviolet light intensities. The expedition, under the leadership of Dr. Louise A. Boyd, was undertaken at the request of the Government, Dr. Boyd having been appointed a consulting expert of the National Bureau of Standards. The U. S. Coast Guard and the Department of Terrestrial Magnetism of the Carnegie Institution cooperated in the arrangements for the expedition.

At a dinner of the citizens of Chicago on September 26 at which the attendance was 800, it was reported that \$9,200,000 had been subscribed to the fiftieth anniversary fund of \$12,000,000 of the University of Chicago. It is planned to raise the balance of the money over a period of five years.

THE Congress of the United States on September 15, as reported in the *Journal of the American Medical Association*, completed legislative action on a bill authorizing the War Department to purchase for \$1,000,000 a site near the Folger Shakespearean Library for the new Army Medical Library and Museum to cost \$3,750,000.

THE School of Medicine and Dentistry of the University of Rochester received more than \$900,000 last year through the will of Dr. Henry C. Buswell. It will now receive the same amount under the will of his wife, Mrs. Bertha H. Buswell. Mrs. Buswell died on July 30. Her will makes available ultimately to the Medical School a trust fund of \$925,164.

A LARGE collection of cactus plants, a gift of Mexico to the United States, was taken to the New York Botanical Garden on September 1 after a two months' display at Rockefeller Center, to be made a permanent part of the cactus collection. The gift was officially accepted last July by Dr. William J. Robbins, director of the garden.

## DISCUSSION

### THE EFFECTIVENESS OF EQUI-MOLAR QUANTITIES OF VARIOUS CARDIAC GLYCOSIDES

It has recently been re-emphasized<sup>1</sup> that the human therapeutic doses of the several pure cardiac glycosides are not predictable from animal toxicity assays. It has, apparently, not been pointed out that in the cases of certain comparable glycosides for which the single dose, or short-time interval multiple intravenous dose, for "full digitalization" in auricular fibrillation is known, there is remarkably small difference in the

molar quantities of the drugs necessary to produce comparable effects. Furthermore, in at least one glycoside differing from others in the chemical configuration at the C<sub>3</sub> position the molar quantities of drug necessary to produce comparable therapeutic effects are widely different.

In the accompanying Table I are shown the intravenous "full digitalizing doses" for auricular fibrillation, together with cat lethal assay figures and certain chemical data for five pure glycosides and one mixture. It will be noted that, for the first four sub-

<sup>1</sup> H. Gold and McK. Cattell, *SCIENCE*, 93: 197, 1941.

stances listed, the full therapeutic doses expressed in micromols are of similar magnitude. The agreement is better than that obtained if animal lethal potencies are compared. In these four glycosides the hydroxyl

TABLE I

Glycoside	Molecular weight	Intra-venous digitalizing dose for man			Configuration C <sub>2</sub>	Sugar
		mg	micromol†	Cat lethal micromols*		
Ouabain	584	1.0 <sup>a</sup>	1.7	0.21	$\alpha$ -OH	Rhamnose
Digitoxin	764	1.2 <sup>a</sup>	1.6	0.43	$\alpha$ -OH	Digitoxose
Lanatoside C	984	1.5 <sup>a</sup>	1.5	0.22	$\alpha$ -OH	Digitoxose
Digoxin	780	1.0 <sup>a</sup>	1.3	0.28	$\alpha$ -OH	Digitoxose
		1.5 <sup>a</sup>	1.9			
Thevetin	858	4.2 <sup>b</sup>	4.9	1.06	$\beta$ -OH	Digitalose?
Scillarens A and B	692	0.5 <sup>b</sup>	0.7	0.22	no-OH?	Rhamnose
		0.7	1.0			

\* The correction for water of crystallization has been neglected in these calculations. The value is unknown for the materials used by the several investigators. If the proper correction could be applied the molar dosages would be smaller, the largest correction probably being for ouabain.

at C<sub>3</sub> in the nucleus has the  $\alpha$  configuration. Fieser<sup>9</sup> has pointed out certain correlations between physiological activity measured by toxicity and the configuration at the C<sub>3</sub> position.

In the case of thevetin the human intravenous dose in question is about three times as great as in the first four on a molar basis. In this glycoside the hydroxyl at C<sub>3</sub> has the  $\beta$  position.

On the basis of one report on the use of a mixture of Scillarens A and B a somewhat lower effective dose is indicated. The structures of Scillarens A and B have not been satisfactorily investigated, but absence of the hydroxyl at C<sub>3</sub> has been reported.

The comparable full therapeutic doses for the glycosides ouabain, digitoxin, lanatoside C and thevetin are satisfactorily established. In the cases of the other glycosides less extensive studies have been made. Moreover, it must be pointed out that the criterion of effectiveness in studies on rapid digitalization in auricular fibrillation is an arbitrary one, namely, a reduction in pulse rate, usually to 80 per. minute or below, within a specified time. Although it has fre-

<sup>a</sup> J. Wyckoff and W. Goldring, *Arch. Int. Med.*, 39: 466, 1927.

<sup>b</sup> H. Gold, N. Kwit and McK. Cattell, *Jour. Pharmacol. and Therap.*, 69: 177, 1940.

<sup>c</sup> N. Kwit, H. Gold and McK. Cattell, *Jour. Pharmacol. and Therap.*, 70: 254, 1940.

<sup>d</sup> Medical Research Council of the British Medical Association.

<sup>e</sup> E. Schwab, *Texas State Jour. Med.*, 35: 619, 1940.

<sup>f</sup> H. Arnold, W. Middleton and K. Chen, *Am. Jour. Med. Sci.*, 189: 193, 1935.

<sup>g</sup> L. Zwillinger, *Wien, Arch. f. inn. Med.*, 31: 201, 1937.

<sup>h</sup> L. F. Fieser, "The Chemistry of Natural Products Related to Phenanthrene," Reinhold, New York, 1937.

quently been so assumed, there is no satisfactory proof that this initial slowing of the pulse is due entirely or majorly to an effect upon the heart directly. In fact, since it is largely abolished by atropin, the early slowing is probably not due to a primary action on the heart, but rather to one upon the nervous cardio-regulatory mechanism. Cushny<sup>10</sup> showed that the early rate changes in digitalization in auricular fibrillation are mediated by vagal influences.

It is by no means certain that the approximate identity of molar doses for full digitalization in fibrillation reported for the first four glycosides in Table I would be found if other criteria were employed. The lack of corresponding agreement in cat lethal doses points to such differences in regard to certain actions at least.

It may be noted that there is no apparent correlation between the nature of the sugar in the glycoside and the physiological action in question.

Attention is being called to the remarkable coincidence of human intravenous doses of several pure glycosides for a particular effect, not so much because it is believed that the configurational peculiarity referred to is more important than others may be found to be, particularly if other criteria of effectiveness are studied, but rather to emphasize the possibility and desirability of further studies in the direction of correlation of action with structure.

MAURICE B. VISSCHER

JOHN S. LADUE

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# A NOTE ON SZENT-GYÖRGYI'S "TOWARD A NEW BIOCHEMISTRY"

In his recent paper<sup>1</sup> Professor Szent-Györgyi advances the hypothesis that a quantum of energy, made available at one point in a living system by chemical action or absorption of light, for example, may be transmitted to a relatively distant point of the system without degradation or dispersion, there to cause some highly localized reaction, such as photosynthesis or the splitting of a protein. The examples cited by Professor Szent-Györgyi prove, of themselves, that this brilliant hypothesis must be considered in any future biochemical or biophysical speculation.

Professor Szent-Györgyi postulates, in his paper, that the mechanism whereby this energy is transmitted is that which has proved effective in fluorescent crystals of ZnS and other substances, the excitation of an electron to an unfilled extended state "belonging" to the entire structure rather than to one or two atoms. To the present writers, this second postulate would appear to limit seriously the generality of the original

<sup>10</sup> A. Cushny, "The Action and Uses of Digitalis and Its Allies," Longmans, Green and Co., London, 1925.

<sup>1</sup> SCIENCE, 93: 609, 1941.

hypothesis, without bringing any compensatory advantages. As a matter of fact, the whole chemical and physical behavior of proteins and other biochemical substances would suggest a Van der Waals' binding, which does not have extended electron states, rather than the electron band binding typical of salt or the diamond. There are other mechanisms already well known to which appeal may be made.

It is well known that neutral or excited atoms, molecules or free radicals may be adsorbed on solid or liquid surfaces as a mobile two-dimensional gas. Such excited mobile entities constitute a second possible mechanism for the effects which Professor Szent-Györgyi discusses. Others are known, and it would be a daring biologist who would suggest that there are no more undiscovered mechanisms.

To summarize, this note suggests that Professor Szent-Györgyi's hypothesis may be of greater use to biology if it is left in its simplest and most general form, "There exists a mechanism which permits the energy of absorbed light or chemical reaction provided in one portion of a living system to be available, without degradation or dispersion, for chemical reactions in relatively distant portions of the system," without tying to any particular mechanism or even to any known mechanism, until much more information is available.

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### ONE SOURCE OF CLAY BALLS

THE Smoky Hill River has a variable flow like all the streams of Western Kansas. Commonly it occupies only part of its channel. During high water and its recession much mud is plastered on the banks and bars. During the succeeding low-water stages mud cracks develop in this layer, often penetrating to considerable depth. As the mud dries further the layers become separated. The oblong, flattened chunks of dried mud which result from the cracking and separation of layers are later washed or otherwise tumbled into the stream.

The mud, having been water-laid in that fashion, is of finely divided clay particles, giving a uniform clay which is quite plastic when wet. I have molded bits of this mud and fired them. The chunks which fall into the stream cohere during transport and are rounded by rolling along the stream bed. Some of them are shunted out of the current and come to rest among the pebbles and sand on the shoals and bars, where they may be further rolled, accumulating an armor of sand and pebbles, or they may be buried among the other sediments in the stream bed.

All stages of this process have been observed. My interest was first aroused by finding some isolated clay masses in the sand on the bank of the stream south of Gorham, Kansas. Knowing that the available clays along the course of the stream west of this point are quite limy, I looked for a source of more plastic clay such as in these masses. The stages of development were found just east of Highway U. S. 183 near Schoenchen, Kansas.

GEORGE M. ROBERTSON

FT. HAYS KANSAS STATE COLLEGE

### A FLORIDA WHITE BLACKBERRY

THE author recently discovered a large wild colony of a white-fruited blackberry near Gainesville, Florida, and has named it *Rubus cuneifolius* Pursh, forma *albifructus*. The plants closely resemble those of the species and the fruits differ chiefly in lacking the black color. Experiments will be undertaken to determine the origin of this form and to improve it, if possible, for local use. The white blackberries at present offered for sale are not suited to the Florida climate.

W. A. MURRILL

UNIVERSITY OF FLORIDA

### AN ANALYSIS OF THE MAJOR INTERESTS OF THE MEMBERS OF THE BOTANICAL SOCIETY OF AMERICA

THE recently published Year Book (1940-41) of the Botanical Society of America<sup>1</sup> includes a list of members with their addresses and major fields of interest. A study was made of the latter to determine the distribution of interests among the various botanical sub-sciences. Table 1 presents the results of this analysis. It will be noted that approximately one half of the total "interests," i.e., 948, lie in the morphological sciences. The low percentages of women interested in the fields of plant pathology (6 per cent.), plant geography (3 per cent.), economic botany (6 per cent.) and phylogeny (0 per cent.) are noteworthy.

It should be emphasized that the figures in the table do not indicate numbers of individuals in the various divisions of plant science, for many of the botanists listed in the Year Book have given several fields of interest. Therefore, this table is a summary of *interests*, not *individuals*. Accordingly, the fact that the total number of "interests" listed in the table is 1,829, whereas there are but 1,365 members in the society, should occasion no surprise. It should also be pointed out that this table gives but a partial picture of the "interests" of American botanists, for many plant scientists are not members of this society but may be affiliated with various special organizations, such as

<sup>1</sup> Miscellaneous Series, Publication 124, January, 1941, Office of the Secretary, New Haven, Conn.

the American Phytopathological Society, the American Society of Plant Physiologists, the Ecological

TABLE 1

Sub-science	"Inter-ests" of men	"Inter-ests" of women	Total	Per cent of women
Systematic botany . . . . .	199	34	233	15 per cent
Morphology . . . . .	165	54	219	25 " "
Cytology . . . . .	124	32	156	21 " "
Mycology . . . . .	107	22	129	17 " "
Anatomy . . . . .	70	26	105	25 " "
Algebra . . . . .	30	9	39	23 " "
Paleobotany . . . . .	31	4	35	12 " "
Bryology . . . . .	17	7	24	29 " "
Phylogeny . . . . .	8	0	8	0 " "
Total of morpho-logical sub-sci-ences . . . . .	760	188	948	20 " "
Physiology . . . . .	349	57	406	14 " "
Pathology . . . . .	143	9	152	6 " "
Ecology . . . . .	122	17	139	12 " "
Genetics . . . . .	100	20	120	17 " "
Plant Geography . . . . .	32	1	33	3 " "
Economic Botany . . . . .	29	2	31	6 " "
Grand Total . . . . .	1,535	294	1,829	

Society of America, the American Society of Plant Taxonomists, the Genetics Society of America, the Mycological Society of America and numerous other organizations. For example, the American Phytopathological Society has a membership of 1,128; the American Society of Plant Physiologists, 623; the American Society of Plant Taxonomists, 514; and the Mycological Society of America, 384.

Table 1 does not include some of the minor subdivisions listed in the Year Book, such as kryobiology, atmometry and micurgy. One botanist gives as her interests—"pathology; morphology; peanuts."

The five universities with the largest numbers of members are Cornell with 37, California (Berkeley) with 35, Harvard with 33, Wisconsin with 25 and Illinois with 22. Thirty-five members are listed from the U. S. Department of Agriculture in Washington.

OSWALD TIPPO

UNIVERSITY OF ILLINOIS

## SCIENTIFIC BOOKS

### PHYSICAL CHEMISTRY

*Physical Chemistry, A Brief Course.* By LOUIS J. BIRCHER, Ph.D., professor of physical chemistry, Vanderbilt University. xvi + 429 pp. Prentice-Hall Chemistry Series, Wendell M. Latimer, Ph.D., editor. New York. 1940.

THE preface states:

The value of specific training in theoretical or physical chemistry is being recognized not only for students who are majoring in chemistry and chemical engineering, but also for those who are preparing for medicine, biology, geology, agriculture, and other branches of engineering. . . . In an effort to meet the needs of students who can profit by a brief course in physical chemistry taken in the intermediate college years, certain materials which seem particularly useful have been selected from the larger field of theoretical chemistry. . . . This material and certain other topics that are included should serve as a background for advanced work in chemistry or for those other sciences in which chemistry plays an important part.

"Each part of the book stresses a phase of the problems of solubility and reactivity." Part I (pp. 3-108) deals with the role played by atomic and molecular structure; Part II (pp. 109-226), transitions from state to state and fugacity as a controlling factor in chemical reactivity; Part III (221-358), physico-chemical change, reaction velocities and the methods of measuring reactivity; Part IV (359-420), directions for 12 laboratory experiments.

Simple proportion and the natural logarithm constitute the mathematics necessary for understanding the equations in this book. Most of the subject matter is to be found to-day in the better type of college texts

on inorganic, qualitative and quantitative analysis. The merit of the book consists in the organization of this material in one volume for those students of agriculture, biology and medicine who do not have the preparation for a standard course in physical chemistry for which a knowledge of elementary calculus is prerequisite. For this group of students the book can be recommended as a readable and appropriate text.

However, if the book is addressed to students of chemistry, chemical and other branches of engineering, it should be pointed out that the American Chemical Society's committee has recently taken the position that they do not recognize a course in physical chemistry which does not require the use of the calculus as meeting their requirements for accrediting a school.

The use of fugacities is properly emphasized as "more exact measures of reactivity," but it is questionable if fugacity merits the space assigned when more immediately practicable concepts for the students addressed are necessarily dismissed with elementary statements and problems.

The distinction between reactivity and rate of reaction is not clear. This is evident from the highly plausible, but nevertheless incorrect statement (p. 226): "*The number of collisions between the molecules involved in a chemical reaction is proportional to the product of the active masses (activities), a, or often, less accurately, the partial pressures or concentrations of the several reacting substances.* (Italics mine.)

On pages 226-227, this "generalized" treatment leads to equations for the velocity of a reaction as proportional to the product of activities! Later in the

chapter on reaction velocity (p. 343), these equations are referred to, but become, without explanation, the products of concentrations. Nothing is said about the critical complex or the importance of activities and their coefficients at a point where they are of the greatest importance. It has been repeatedly emphasized in the American literature for the past fifteen years that if the italicized statement and the equations (p. 226-227) were correct, there could be only negative salt catalysis and never positive salt catalysis in contradiction to well established experimental evidence.

The author is to be commended for introducing the concept of osmotic coefficient. This innovation, for an elementary book, will save the student from unlearning later erroneous statements about ionic dissociations.

Unfortunately, however, after all the preparation on fugacity, activity of the electrode (p. 273) and of the ions, (p. 268), one learns (p. 274), that "hydrogen ion concentration is the most exact measure of the 'acidity' of a solution." The student is given no inkling that pH really involves the activity and not the concentration of hydrogen ion.

VICTOR K. LAMER

COLUMBIA UNIVERSITY

### KINETIC THEORY OF GASES

*An Introduction to the Kinetic Theory of Gases.* By SIR JAMES JEANS, O.M., F.R.S. 311 pp. New York: The Macmillan Company; Cambridge University Press. 1940. \$3.50.

THIS book lies somewhere between a treatise such as represented by the author's "The Dynamical Theory

of Gases" and a text-book for advanced students. It is, in fact, the author's intention to supply a book which will provide such knowledge of the kinetic theory as is required by the average serious student of physics and physical chemistry, and at the same time give the mathematical student the equipment he should have before undertaking the study of specialist monographs.

The book differs from the author's larger work above cited in that the subject is covered in a more elementary manner, with less mathematical rigidity and with greater attention to the physical and descriptive aspects. The various concepts are illuminated, moreover, to an extent unusual in a book of this kind, by the inclusion of accounts of experimental investigations.

The book covers a wide field, and it is inevitable that there should be a considerable range of difficulty in the various parts. It is probable that the student who has already an acquaintance with the subject will get more benefit from the work than will a beginner; and to the semi-advanced student the book will constitute a valuable reference to which he may turn to refresh his memory when the practical need occurs for drawing upon various parts of the subject.

The work is rich in references both on the experimental and theoretical sides. It contains much useful numerical material and a helpful appendix, containing certain special standard theorems and also tables convenient for numerical calculations associated with the subject.

W. F. G. SWANN

BARTOL RESEARCH FOUNDATION  
OF THE FRANKLIN INSTITUTE,  
SWARTHMORE, PA.

## SPECIAL ARTICLES

### ISOLATION OF THE VIRUSES OF WESTERN EQUINE AND ST. LOUIS ENCEPHALITIS FROM *CULEX TARSALIS* MOSQUITOES<sup>1</sup>

IN North America three types of epidemic virus encephalitis are recognized. Two of these, the eastern and western types of equine encephalomyelitis, are believed to be mosquito-borne. Mosquito transmission has been repeatedly demonstrated in the laboratory (summarized by Davis<sup>2</sup>), but until now the virus has never been isolated from mosquitoes collected in epi-

demie areas. With respect to the St. Louis encephalitis virus opinions of observers have differed as to the mode of transmission. Lumsden<sup>3</sup> concluded that it was probably transmitted by *Culex* mosquitoes. Mitamura and associates<sup>4</sup> have reported successful transmission of this virus in the laboratory by *Culex pipiens*.

In the Yakima Valley, Washington, evidence was obtained by Hammon<sup>5</sup> and Hammon and Howitt<sup>6</sup> during the summer of 1940 indicating the probable presence in man and horses of both the western equine

<sup>1</sup> Part of a Cooperative Survey of Encephalitis in the Yakima Valley by the University of California, the State College of Washington, the Washington State Health Department, the Yakima City-County Health Department and the U. S. Department of Agriculture, Bureau of Entomology and Plant Quarantine. Aided by a grant from the Natural Foundation for Infantile Paralysis, Inc.

<sup>2</sup> W. A. Davis, *Amer. Jour. Hygiene*, 32: 45, 1940.

<sup>3</sup> L. L. Lumsden, Unpublished official report, 1933.

<sup>4</sup> T. Mitamura, S. Yamada, H. Hasato, K. Mori, T. Hosoi, M. Kitaoka, S. Watanabe, K. Okubo and S. Tanjin, *Tr. Jap. Path. Soc.*, 27: 573, 1937.

<sup>5</sup> W. McD. Hammon, *Jour. Am. Med. Assn.*, 117: 161, 1941.

<sup>6</sup> W. McD. Hammon and B. F. Howitt, To be published.

virus and the St. Louis virus. These workers outlined evidence which suggested a *Culex* mosquito as the likely vector for the latter. In May of 1941 an extensive, coordinated field and laboratory survey of this region was begun. This preliminary report deals with the isolation of both the St. Louis and the western equine viruses from *Culex tarsalis* taken in routine entomological collections where human encephalitis cases occurred during this or the previous year. These collections were planned with the purpose of finding, if possible, either or both of the encephalitic viruses believed to be present in the region. The same survey, by serum neutralization tests of birds and mammals, indicated probable wide-spread infection by both (Hammon, Gray, Evans, Izumi and Lundy<sup>1</sup>).

Live arthropod specimens were collected by means of specially constructed light traps, sweepings and hand collections. These arthropods, after identification in the field laboratory under light chloroform anesthesia, were sealed in hard glass shell vials by drawing in a gas-oxygen flame. They were then frozen, stored and shipped in CO<sub>2</sub> ice to the San Francisco Laboratory. Here, in lots of a single species containing from 5 to 150 specimens, the arthropods were washed in saline, then ground in a mortar with alundum in 3.0 ml of 30 per cent. sheep serum-saline. The supernatant, after 10 minutes centrifugation at 16,000 r.p.m. in an International Centrifuge Multispeed Head, was cultured and 5 Swiss mice, Rockefeller strain, inoculated with .03 ml intracerebrally. All mice were observed for 21 days. Several lots of *Aedes campestris* were infected with the western equine virus in the field laboratory and served as controls for the method of shipping and handling for virus isolation.

From the arthropod material collected this season 9,503 specimens have been tested for the presence of virus. This includes 7,619 mosquitoes,<sup>2</sup> 1,458 specimens of other flies<sup>3</sup> and 426 miscellaneous biting arthropods. Of these arthropods, *C. tarsalis*, of which 3,293 specimens have been tested, is the only one to date from which a virus has been isolated. From a pool of 66 mosquitoes (Pool No. 103 collected July 9th) the St. Louis virus was isolated, and from a pool of 125 (Pool No. 116 collected July 15th) the western equine virus was recovered.\*

<sup>1</sup> W. McD. Hammon, J. Gray, Jr., F. C. Evans, E. M. Izumi and H. W. Lundy, *Science*, 94: 2489, 1941.

<sup>2</sup> *Anopheles maculipennis freeborni*, *Theobaldia inornata*, *Theobaldia incidens*, *Aedes vexans*, *Aedes dorsalis*, *Aedes campestris*, *Aedes nigromaculis*, *Aedes taeniorhynchus*, *Aedes cinereus*, *Aedes lateralis*, *Culex tarsalis*, *Culex pipiens*.

<sup>3</sup> Simuliidae (black flies), Tabanidae (horse flies), Muscidae (house flies, horn flies and stable flies).

\* Since this paper was written 2 other viruses have been isolated from lots of *C. tarsalis*. These have not yet been identified.

#### ISOLATION OF ST. LOUIS VIRUS

Among five mice inoculated with Pool No. 103 two were found in convulsions 8 days after inoculation. These were sacrificed and their brains were found to be bacteriologically sterile. Each brain was passed separately to 3 other mice by intracerebral inoculation of a 10 per cent. suspension. These came down with encephalitic symptoms or were found dead between the 4th and the 6th day. After the virus was well established in mice, steps were taken to identify it. It was found to pass through both N and V Berkefeld filters. It produced no symptoms after intracerebral inoculation in two guinea pigs, a rabbit, a monkey (*Macacus rhesus*) and a lamb. A fatal infection was produced in mice by intranasal inoculation and by intraperitoneal inoculation of over 100,000 fatal intracerebral doses. No symptoms were produced when a similar dose was given subcutaneously. These tests were sufficient to tentatively identify the virus as that of St. Louis encephalitis.

A neutralization test was set up against normal rabbit serum, hyperimmune western equine guinea pig serum and hyperimmune St. Louis rabbit serum. At the same time the St. Louis serum was titrated against a known strain of St. Louis virus. Both the "Culex 103 virus" and the St. Louis virus were neutralized to the same degree by the hyperimmune St. Louis serum. The western equine serum afforded no protection. It appears from these findings that the virus isolated from this pool of *C. tarsalis* is that of St. Louis encephalitis.

#### ISOLATION OF WESTERN EQUINE VIRUS

Among mice inoculated with Pool No. 116 one was observed in rolling convulsions 6 days after inoculation. It was sacrificed, and after the brain was found to be bacteriologically sterile it was passed by intracerebral inoculation to four other mice. On the fourth day the first of these showed suspicious signs of illness and brain passage was made to 2 guinea pigs and 4 mice. The guinea pigs developed high temperatures on the third day. One died 24 hours later and the other was sacrificed on the fifth day. Neither guinea pig was paralyzed or noted to have convulsions. Subsequent passages in guinea pigs resulted regularly in paralysis of the hind quarters and abdominal muscles, and running convulsions typical of equine encephalomyelitis. The pathogenic agent was found to pass through both Berkefeld V and N filters. Although adaptation to guinea pigs was easily accomplished, the virus was not readily adapted to mice.

Experiments were done to determine if the virus were that of western equine encephalomyelitis. In one instance a normal guinea pig and one previously immunized to the western equine virus were inoculated

intracerebrally with a 10 per cent. suspension of the brain of a guinea pig infected with the "Culex 116 virus." The normal guinea pig succumbed in the course of a typical encephalitic infection, but the immune animal remained normal. In the next experiment two normals and two hyperimmune controls were used and similar results obtained. It appears therefore that the virus obtained from this pool of *C. tarsalis* is that of western equine encephalomyelitis.

Experiments are now in progress to test the ability of *C. tarsalis* to serve as a host to, and to transmit these viruses. Already *C. tarsalis* has been fed on a guinea pig infected with the western equine virus and the virus readily demonstrated after 5 days incubation. Until actual transmission of one or both of these viruses has been demonstrated the role of this mosquito as a vector is not proven. These findings have, however, increased the evidence incriminating mosquitoes as vectors of these encephalitic virus diseases.

#### ADDENDA

*Culex tarsalis* is a North American species distributed throughout the states west of the Mississippi River. In the Yakima Valley it is the most common mosquito, and its larvae are found in many types of water: permanent ponds, irrigation seepage, barnyard drainage and sewage. Adults were taken in all areas where light traps were run, and were collected in large numbers in shelters such as barns and houses. In all areas of the Valley where encephalitis occurred in man or horses it was collected in significant numbers. It is more abundant than *Culex pipiens*, the other common Culecine of this area. In temperate regions adult females are reported to hibernate in sheltered places, emerging in the spring to commence egg laying (Hearle).<sup>10</sup>

The feeding habits of *C. tarsalis* have not been extensively studied. Direct observations made in the Yakima Valley indicate that it feeds on man, horses, mules, cows and mallard ducks. Other workers have indicated that it feeds on avian blood (Freeborn)<sup>11</sup> and on man (Hearle)<sup>10</sup>.

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<sup>10</sup> E. Hearle, *Nat. Res. Council Rept.* 17, Ottawa, Canada, 1926.

<sup>11</sup> S. B. Freeborn, *Univ. of Calif. Publ. Tech. Bull. Entom.*, Bull. III, 5: 333, 1926.

#### DIAGNOSIS OF EPIDEMIC ENCEPHALITIS BY COMPLEMENT-FIXATION TEST

DURING the months of August and September, 1941, encephalitis in man occurred in epidemic form in Manitoba, Canada, and central United States. Blood sera from patients were dispatched to the Rockefeller Institute for diagnosis.<sup>1</sup>

Complement-fixation tests were carried out on each serum against the antigens of Western equine encephalomyelitis, Eastern equine encephalomyelitis, lymphocytic choriomeningitis and St. Louis encephalitis. The sera were inactivated at 60° or 65° C. and tested both undiluted and in twofold dilutions through 1:16 according to the method we have previously described.<sup>2</sup>

Of thirty-six sera from Manitoba, twenty-two gave a strong and completely specific reaction with the Western equine encephalomyelitis antigen; of eight sera from Colorado, two exhibited a similarly strong specific reaction. The titres of the positive sera, as determined by the highest dilution of serum giving a 2+ or better reaction, were 1:4 in four cases, 1:8 in three cases and 1:16 or 1:16+ in seventeen cases.

Of nine sera drawn from patients within 10 days or less after onset of illness, none was positive; whereas of thirty-five sera drawn from patients 11 to 30 days after onset, twenty-four or 69 per cent. proved positive.

Two samples of serum were obtained from each of two cases in Colorado, and they are of special interest. The first samples from each patient, taken a few days after onset of illness, were negative, whereas the second samples, taken during the second week of illness, gave a strongly specific reaction with Western equine encephalomyelitis antigen.<sup>3</sup>

The above tests indicate that the present epidemic of encephalitis in Manitoba and central United States is caused by the Western equine encephalomyelitis virus and demonstrate the value of the complement-fixation test as a practical and speedy diagnostic tool.

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<sup>1</sup> Sera and brain tissue specimens were kindly sent us by Dr. Daniel Nicholson, Winnipeg, Canada; Captain O. E. G. Gould, Camp Shilo, Manitoba; Lieutenant S. Young, Brandon, Manitoba, and Dr. J. E. Smadel, New York.

<sup>2</sup> J. Casals and R. Palacios, *SCIENCE*, 93: 162, 1941; *Jour. Exp. Med.* (in press), October, 1941.

<sup>3</sup> From the brain tissue of one fatal case of encephalitis in Winnipeg a virus was obtained by inoculation into W-Swiss mice. An antigen was prepared from this virus-containing brain tissue, which fixed complement specifically with known Western equine encephalomyelitis immune serum. Neutralization and protection tests confirmed this result.

## FLUORESCENCE OF HARDERIAN GLANDS IN MICE OF CANCER-SUSCEPTIBLE AND CANCER-RESISTANT STRAINS<sup>1</sup>

In the course of routine examination of mice under ultra-violet light (G.E. B-H4) it was discovered that there was a great variation in red fluorescence in the exposed Harderian glands of mice of the various strains. The degree of variability may be expressed by the symbols 0, +, ++, +++, +++++. The two extreme variants were found in adult mice beyond 300 days of life of the JK cancer-resistant strain (0-+) and mice of the C<sub>3</sub>H strain cancer-susceptible (+++ - +++++). Mice of the inbred strains have shown, so far, a fair degree of constancy, whereas, mice of the NH descent, which are relatively heterozygous (F<sub>5</sub>-F<sub>8</sub>, generations represented) have shown marked individual variability in red fluorescence of the Harderian glands. An age variation was also observed. Before the eyes were open at 14 days, no fluorescence of orbital contents was detected. In early sexual maturity a high fluorescence was seen. This was found to decrease in intensity in JK mice with advancing age and was completely absent in old mice. This decrease in fluorescence with advancing age was not observed in C<sub>3</sub>H mice.

Red fluorescence of the Harderian gland is an indication of the presence of porphyrins (Grafin,<sup>2</sup> Derrien and Turchini<sup>3</sup>). Little is known regarding porphyrins within the body. There is, however, some evidence to indicate that they may be involved in the synthesis or destruction of hemoglobin (Lemberg,<sup>4</sup> Hill and Keilin<sup>5</sup>). Biliverdin results from the oxidative splitting or opening of the porphyrin nucleus of

haemochromogen in the liver (Lemberg<sup>4</sup>). It was found by Strong and Werner<sup>6</sup> that there was a precocious drop in the hemoglobin level in a mouse of the C<sub>3</sub>H strain as compared with one of the JK strain. A similar finding was reported by Strong and Francis<sup>7</sup> in mice of the A (cancer-susceptible) and CBA (partially cancer-resistant) strains. Strong<sup>8</sup> suggested that this precocious drop was due to one of two possibilities; (1) that hemoglobin was being produced at a rate lower than normal, or (2) that it was being destroyed at an abnormally high rate. Porphyrins are also known to be important constituent parts of catalase (Zeile<sup>9, 10</sup> and Stern<sup>11</sup>) the Pasteur enzyme (Stern and Melnick<sup>12</sup>) and cytochrome c (Hill and Keilin<sup>5</sup>).

Thus it is clear that the present observation may be of interest in the investigation of at least two problems: (1) A genetic analysis of the occurrence and transmission of such a variant, and (2) the investigation of various physiological states as influenced by the presence, absence or abundance of such a chemical within the body. Since mice of the JK and C<sub>3</sub>H strains show the maximum degree of difference to both cancer susceptibility and porphyrins in the Harderian gland, such an investigation should include a search for a possible relationship between porphyrins and some physiological process that may be correlated with carcinoma susceptibility.

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## SCIENTIFIC APPARATUS AND LABORATORY METHODS

### A NEW DIGESTION TUBE

THE chemist is often faced with the problem of having to determine accurately, by means of acid digestion, small quantities of protein. During digestion, these protein solutions may bump and foam. The possible loss of material by bumping may usually be controlled by good technique. Occasionally, however, with the most careful technique, loss of material may invalidate the entire procedure.

Certain types of determinations can be effected by

<sup>1</sup> This investigation was aided by grants from The Jane Coffin Childs Memorial Fund for Medical Research and The Anna Fuller Fund.

<sup>2</sup> A. I. Grafin, *Anat. Rec.*, 79: suppl. 25, 1941 (abstract).

<sup>3</sup> E. Derrien and J. Turchini, *Comptes rend. Soc. de Biol.*, 92: 1028-29, 1925.

<sup>4</sup> R. Lemberg, *Biochem. Jour.*, 29: 1322, 1935.

the use of the N.P.N. tube and the Kjeldahl flask, to mention but two of the several digestion tubes and flasks available to chemists. Few of the methods involving the use of the N.P.N. tube are accurate.

<sup>5</sup> R. Hill and D. Keilin, *Proc. Roy. Soc. London*, 107: 286-92, 1930.

<sup>6</sup> L. C. Strong and T. H. Werner, *Am. Jour. Cancer*, 26: 767-69, 1936; 27: 115-19, 1936.

<sup>7</sup> L. C. Strong and L. D. Francis, *Arch. Path.*, 23: 202-06, 1937.

<sup>8</sup> L. C. Strong, *Am. Jour. Cancer*, 27: 500-09, 1936.

<sup>9</sup> K. Zeile and H. Hellström, *Hoppe-Seyler's Zeits. für Phys. Chem.*, 192: 171-92, 1930.

<sup>10</sup> K. Zeile, *Hoppe-Seyler's Zeits. für Phys. Chem.*, 195: 39-48, 1931.

<sup>11</sup> K. G. Stern, *Jour. Biol. Chem.*, 112: 661-, 1936.

<sup>12</sup> K. G. Stern and J. L. Melnick, *Jour. Biol. Chem.*, 139: 301-23, 1941.

<sup>13</sup> Rockefeller Foundation fellow at Yale University, 1940-41.

This is especially true of the protein determination of cerebrospinal fluid, a process associated with so much foaming and bumping that, for clinical purposes, the results are often not as acceptable as they should be. The Kjeldahl method is exact, but its use necessitates a nitrogen distillation system and accurate burettes for back-titrations. The apparatus is expensive and the technique time-consuming.

We have designed and constructed a new digestion tube by means of which the loss of material due to foaming and bumping can be eliminated. The tube

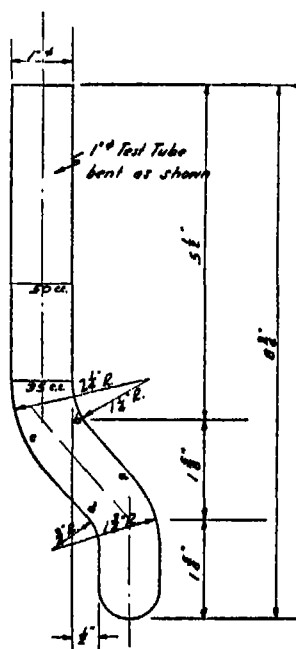


FIG. 1

is designed so that a drop of boiling solution can not be shot directly outwards. When thrown upwards, it must necessarily strike the wall of the tube along the lines "a" and "b" and flow back into the solution. Foam also will rise up between the points "a" and "b" and descend by points "c" and "d." Seldom does it rise beyond the point "b."

By the use of the tube described, the more difficult types of digestion can be performed with ease and accuracy. There is no loss of solution and much saving of time. The most ordinary technique will furnish exact results. The new digestion tube is especially suitable for those methods for which the N.P.N. tube is, at present, used.

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## A TECHNIQUE FOR CONTINUOUS OR INTERMITTENT OBSERVATION OF THE CONTRACTILE VACUOLES OF PARAMECIUM

THE methods commonly used for demonstrating and studying the contractile vacuoles of *Paramecium* have the serious disadvantage of not permitting the observer to view the animals intermittently over a period of several days. In the technique described below, continuous observation is made possible by studying the animals on the surfaces of agar plates.

### PREPARATION AND USE OF THE AGAR PLATES

Filter 1,000 cc of culture medium which has supported a vigorous growth of *Paramecium* through coarse filter paper. The medium should be clear and transparent. Bring the filtrate to a boil and add, while stirring, 10 gms of agar-agar. Boil slowly until all the agar is dissolved. The agar is then poured, while hot, into Syracuse watch glasses to a depth of approximately 5 mm. The agar is then allowed to cool, without agitation, until it is firmly set.

When the agar is set, one drop of a rich culture of *Paramecium* is placed in the center of the dish, which is then tilted from side to side to spread the drop. Within a few minutes enough water has evaporated from the surface to impede locomotion. The animals may then be studied at leisure.

For prolonged observation of the same preparation it is necessary to prevent undue evaporation from the surface of the agar. This is best accomplished by inverting the dish over another watch glass partly filled with water. In this way we have kept and observed animals in the same preparation for as long as ten days. Temporary preparations may be made with distilled water, but the animals do not survive on the surface of agar so prepared.

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## THE NEXT FIFTY YEARS<sup>1</sup>

By President ROBERT M. HUTCHINS

UNIVERSITY OF CHICAGO

THE task which Mr. Harper and his associates set themselves fifty years ago was that of organizing a university. To them a university was, like the German university of that time, an institution dominated by the spirit of inquiry. The characteristic activity of its professors was research.

The task involved selecting men qualified for research, giving them facilities for it, assembling students who could take part in it, and erecting that protection of academic freedom about it which, in the bad old imperial days, guaranteed the independence of the teaching and investigations of the German professor.

The University of Chicago was a university the day it opened. We are now so used to universities that we are apt to think that this achievement, though doubtless unusual, was not very remarkable. We are apt to think that all it required was money and that anybody could have done it if he had had the money that was available to the organizers of the University of Chicago.

But the money was not available. Mr. Rockefeller's original pledge was for \$600,000, and it was conditional on the raising of \$400,000 more. We later became so used to great gifts for universities that we now suppose that all the participants, including Mr. Rockefeller, must have expected him to give the enormous sum of \$1,000,000 which he did give by 1910. But

<sup>1</sup> An address delivered at the Fiftieth Anniversary Convocation of the University of Chicago on September 29.

in 1891 all the funds of Harvard amounted to not much more than seven millions. All the university had fifty years ago was a contingent pledge of \$600,000. The courage of Mr. Harper and his colleagues must be measured by what they had.

Within the memory of living men there was no such thing as a university in this country. Graduate instruction had begun at Yale in the seventies. Harvard was getting under way. But neither was a university, as Chicago understood it, in 1891. Clark, which was having difficulties which Mr. Harper did nothing to alleviate, and Johns Hopkins, which had started fifteen years before, were the only American universities in the Chicago sense. Mr. Harper had originality as well as courage.

The founders succeeded in what they set out to do. They won the battle they fought, and we are the beneficiaries of their victory. We take universities as a matter of course. Even the taxpayers are now willing to support institutions which Mr. Harper would have recognized as great universities. The American university is established.

To the question, "When you get your organization, what are you going to do with it?", the founders of the University of Chicago replied, "We are going to conduct research with it." To say that this answer is unsatisfactory is not to depreciate the accomplishment of those who gave it. It was satisfactory then. American education had begun to suffer from premature senescence. It was rejuvenated by the spirit of inquiry. That spirit, too, has produced the brilliant achievements of American scholarship, which alone justify the toil and treasure that have been lavished upon the American universities, the popular devotion they have commanded, and the faith of the founders of the University of Chicago.

The time of the founders was one of conscious or unconscious agreement upon the ultimate foundations of society and the ultimate purposes of the individual. Though men differed sharply, they differed not so much about their destination as about the methods of arriving at it. They would have been shocked to hear from any responsible person that morality was a matter of opinion, the state an end in itself or God the product of wishful thinking. They did not need to heed the warning of Socrates that the unexamined life was no life for man, because the examination had been conducted long before, and its results were imbedded in the tradition which guided the daily action of men. The American university did not need to reformulate the ideals which should animate mankind, and still less to suggest that ideals were important. All that was needed, men thought, was more knowledge to enable them to reach the goals which they more or less clearly had before them. The University of Chicago was founded to provide that knowledge. It

was to supply the means to improve a civilization the main lines of which were laid down and the aims of which were taken for granted by those who enjoyed its blessings.

In those areas in which the last half century has brought no change in the fixity and clarity of beliefs the American university has surpassed the highest hopes of its founders. People still want material goods; and through the natural sciences we can now produce a range and luxuriance of such goods that would embarrass a Roman emperor. People still want health; and through the American university we may sometime achieve a longevity comparable to that of the heroes who flourished before the Flood. Wherever we know what we want, wherever we want it badly enough, the knowledge acquired by research can help us get it.

But no matter how we may struggle to deceive ourselves, we vaguely feel that bodily goods and external goods are not the ends of life. They are means to other goods beyond them. Now we no longer join in conscious or unconscious agreement on the nature and existence of the other goods beyond. The last half century has substituted confusion and bewilderment for the simple faith in which Mr. Harper, Mr. Rockefeller and their collaborators embarked upon their enterprise at Chicago. That civilization which we thought so well established seems on the verge of dissolution. The religious belief which led the Baptists to found this university does not sustain its constituency to-day. Instead of feeling that we were born with a common inheritance of ideas about the purpose of the state and the destiny of man, we listen to competing affirmations of contradictory positions on these issues without being able either to accept or deny them in a manner satisfactory to ourselves. Confronted by the great question of peace or war, we can not make up our minds what we want to defend, why or how. Though the death rate is declining, we do not know what to do with our lives.

Since we are confused about ends, we do not know how to employ means. Though our means of improving the material conditions of existence exceed those of any previous generation, we could not use them, in the great depression, to save our fellow-citizens from starvation and despair. The means of improving the material conditions of existence are now diverted to the extermination of mankind on a grander scale than ever before.

Gibbon, in his celebrated chapter summarizing the reasons for the fall of the Western Empire, relieves the fears of Europe by saying that there will never be another barbarian conqueror. His reason is simple. War now requires the knowledge of a large number of arts and sciences. Hence to excel in war the barbarian must cease to be barbarous. Since man first

discovered how to master the forces of nature all history has been tending toward this goal. Gibbon's final remark is, "We may therefore acquiesce in the pleasing conclusion that every age of the world has increased and still increases the real wealth, the happiness, the knowledge and perhaps the virtue of the human race."

The conclusion is pleasing; the premise is false. Professor Nef's researches show that the rate of increase of real wealth is rapidly declining. Though knowledge has grown from more to more, happiness and virtue have not. And we see that a barbarian conqueror equipped with knowledge is more barbarous, as well as more dangerous, than any of his unlettered predecessors.

The centrifugal forces released through the dissolution of ultimate beliefs have split the universities into a thousand fragments. When men begin to doubt whether there is such a thing as truth or whether it can ever be discovered, the search for truth must lose that precision which it had in the minds of the founders of the University of Chicago. If we doubt whether man is rational, we can not lightly put our trust in the exercise of reason. And if the traditional notion of freedom, when dragged up out of our subconscious, looks less impressive than we had always supposed it would; if we think on the one hand that freedom is doing as one likes, and on the other that man is a mere automaton, free inquiry ceases to be that infallible guide to terrestrial salvation which Mr. Harper thought it was. After fifty years we must confess that the beacons established to illuminate the pathway of our people give a light that is flickering and dim. The universities, instead of leading us through the chaos of the modern world, mirror its confusion.

If we are to do for our own day what the founders of the University of Chicago did for theirs, we shall have to continue what they did, and we shall have to do something more. We shall have to recapture, revitalize and reformulate for our time the truths which gave purpose and significance to their work. We are in the midst of a great moral, intellectual and spiritual crisis. To pass it successfully or to rebuild the world after it is over we shall have to get clear about those ends and ideals which are the first principles of human life and of organized society. Our people should be able to look to the universities for the moral courage, the intellectual clarity and the spiritual elevation needed to guide them and uphold them in this critical hour. The universities must continue to pioneer on the new frontiers of research. But to-day research is not enough either to hold the university together or to give direction to bewildered humanity. We must now seek not knowledge alone, but wisdom.

This is what the University Grants Committee of England meant when it said: "Here arises the responsibility of the universities. They are the inheritors of the Greek tradition of candid and intrepid thinking about the fundamental issues involved in the life of the individual and of the community, and of the Greek principle that the unexamined life is no life for man."

Candid and intrepid thinking about fundamental issues—in the crisis of our time this is the central obligation of the universities. This is the standard by which they must be judged. This is the aim which will give unity, intelligibility and meaning to their work. This is the road to wisdom. Upon that road the American university will regain its own soul and bring hope and comfort to a distracted world.

## HYPOTHESIS AS TO THE ORIGIN OF COSMIC RAYS AND THE EXPERIMENTAL TESTING OF IT IN INDIA AND ELSEWHERE<sup>1</sup>

By Dr. R. A. MILLIKAN, Dr. H. V. NEHER and Dr. W. H. PICKERING

CALIFORNIA INSTITUTE OF TECHNOLOGY

THE hypothesis here adopted as to the mode of origin of the cosmic rays makes possible the prediction of five definite vertically incoming cosmic-ray bands. As the observer moves north from the magnetic equator each of these five bands should begin to reach the earth at a particular latitude and continue reaching it at all more northerly latitudes. Between each latitude of first entrance of a band of

particular energy and the latitude of first entrance of the band of next lower energy there should be found a plateau of constant vertically incoming cosmic-ray energy. Four such plateaus should be experimentally observable.

The hypothesis rendering possible these predictions rests upon five major discoveries made by the workers in the Norman Bridge Laboratory of Physics at the California Institute at Pasadena. These discoveries are (1) that more than 60 per cent. of all incoming cosmic-ray energy is of the nature of incoming

<sup>1</sup> From a symposium celebrating the Fiftieth Anniversary of the University of Chicago, the American Association for the Advancement of Science collaborating.

charged-particle bullets (either electronic or protonic), each of energy between 2 billion electron volts and 15 billion electron volts; (2) Neddermeyer and Anderson's discovery of the production by nuclear impacts within the atmosphere of mesotrons which serve as the chief carriers of the cosmic-ray energy down to the lower levels of the atmosphere; (3) Bowen's remarkable discovery that atoms, when out in interstellar space, are able to undergo atomic transformations forbidden to them within the stars, and (4) Bowen and Wise's discovery that in ring nebulae, trillions of miles away from the exciting star, and therefore presumably reflecting conditions in interstellar space, there are five of the atoms, namely, helium, carbon, nitrogen, oxygen and silicon, each of which is more than ten times more abundant than any other atom save hydrogen (which must be excluded from measurable cosmic-ray effects because of the smallness of its rest-mass energy); and (5) Lauritsen and Fowler's discovery in the Kellogg Radiation Laboratory that a part, at least, of the rest-mass energy of an atom has the power under suitable conditions of transforming itself directly into the creation of a positive-negative charged-particle pair.

The hypothesis made in view of these five discoveries is that while the evolution of energy by the stars is maintained, as Bethe has recently shown, by the *partial* transformation within the stars of the rest-mass energy of hydrogen into radiant energy through the building of helium, carbon and other atoms out of hydrogen, and the release through this process of the so-called "packing-fraction" energy, the energy of cosmic rays on the other hand is maintained by the occasional *complete* transformation in interstellar space of the rest-mass energy of the atoms of helium, carbon, nitrogen, oxygen and silicon (and even heavier aggregates) into cosmic rays, each such event presumably creating either an electron pair or a proton pair (these two events are indistinguishable by our geographic experiments), though an occasional photon pair, or neutron pair, need not *necessarily* be excluded.

The foregoing hypothesis requires that the cosmic rays of measurable energy reveal a spectral distribution of five distinct, definitely measurable bands as follows: (1) a band of rays each having an energy of 1.9 billion electron volts produced by the annihilation, or complete transformation, in interstellar space, of the rest-mass energy of the helium atom; (2) a carbon-atom-annihilation band of energy 5.6 billion electron volts (b.e.v.); (3) a nitrogen-atom band of energy 6.6 b.e.v.; (4) an oxygen-atom band of energy 7.5 b.e.v., and (5) a silicon-atom band of energy 13.2 b.e.v.

The hypothesis requires further that there should

be in India, for vertically incoming rays between the magnetic equator and magnetic latitude about 20 degrees N. a plateau of unchanging cosmic-ray intensity with latitude; it requires another such plateau between the latitudes of entrance of the bands due to the silicon and oxygen atoms; it requires a third such plateau between the great band produced by the annihilation of the carbon, nitrogen and oxygen atoms, and that due to the annihilation of helium; and, finally, it requires a fourth such plateau north of Bismarck, North Dakota, where as the observer goes northward the helium band should first be able to get vertically through the blocking effect of the earth's magnetic field and should then be able to enter the earth in full strength at all more northerly latitudes.

The experimental evidence that has been so far obtained in India and elsewhere for the existence of these five bands and four plateaus may be thus summarized. The India evidence seems to be good for the existence of the plateau of constant cosmic-ray intensity from the Equator up to Agra (17° N) and for the appearance just north of Agra of a band that can be identified with that due to silicon. There is some evidence for the existence of the flat plateau just north of the latitude of first entrance of the hypothetical silicon band. There is unambiguous evidence for the entrance at about the computed latitude of a very strong band at between 5.5 and 7.5 b.e.v., and this we tentatively identify with the joint carbon, nitrogen, oxygen bands which, however, we have not yet been able to resolve. There is a little evidence for the existence of a plateau of constant cosmic-ray intensity between the latitudes at which the carbon and the helium bands should appear, and there is fair evidence, too, for the existence of a flat plateau north of the latitude of entrance of the hypothetical helium band, the real existence of which may be stated to have been rendered probable. Not only are all the predicted latitudes in reasonable agreement with the observations, but also the observed intensities are of the right order of magnitude.

Further experiments are being made to see whether better designed apparatus will render the nature of the evidence better or worse for the hypothesis, and new experiments in Mexico and the United States are planned for the coming months.

This comparison of prediction and experiment has been made possible largely through the generous support of the investigation by the Carnegie Corporation of New York and the Carnegie Institution of Washington. The success of the work in India was made possible by the extraordinarily generous and complete cooperation of the British Indian Meteorological Service.

## THE DEPARTMENT OF ASTRONOMY OF THE UNIVERSITY OF CHICAGO

By Dr. OTTO STRUVE

YERKES OBSERVATORY

THE University of Chicago is celebrating this month its fiftieth anniversary. As a part of this celebration the Yerkes Observatory organized in September a symposium on "Astronomical Spectra," which followed immediately after the annual meeting of the American Astronomical Society. The speakers at the symposium were Dr. R. C. Williams and Dr. L. Goldberg, of Michigan, Dr. R. Wildt and Dr. H. N. Russell, of Princeton, Dr. D. H. Menzel, of Harvard, Dr. M. Schwarzschild, of Columbia, Dr. P. W. Merrill and Dr. R. Minkowski, of Mount Wilson, Dr. A. B. Wyse, of Lick, Dr. G. P. Kuiper, Dr. W. W. Morgan, Dr. P. Swings and Dr. O. Struve, of Yerkes. The discussion ranged from the theory of radiative transfer in stellar atmospheres by Menzel to the peculiar behavior of forbidden emission lines in "symbiotic" stars (i.e., in stars consisting of two or more components of different physical characteristics) by Merrill. Wildt presented new and important ideas concerning continuous absorption by molecules in stellar atmospheres, and Russell reviewed the latest data on the relative abundances of the elements, a problem which has a special bearing upon Bethe's cycle of energy generation. Williams presented the observational results obtained by him and by other workers on the energy distribution of continuous stellar spectra and stressed some serious discrepancies which still exist in the ultraviolet region. Wyse presented new spectroscopic results secured at the Lick Observatory for faint planetary nebulae and discussed the abundances of the elements in these objects. Goldberg discussed the theory of atomic line intensities and gave a comparison of the results obtained from wave mechanics with the observed intensities. Schwarzschild discussed the theory of pulsating stars. Morgan developed the classification of stellar spectra and Kuiper gave his latest summary of observations of several thousand stellar spectra—culminating in a preliminary table of relative abundances of different species of stars in the galaxy. Swings outlined the properties of Wolf-Rayet stars from recent observations at the McDonald Observatory. Minkowski summarized the Mount Wilson observations of supernovae and Struve outlined a working hypothesis for the interpretation of extended stellar atmospheres.

The discussions were exceedingly lively and the attendance was unexpectedly large. We can not hope that each symposium will lead to such a rapid and dramatic climax as the discovery in the laboratory and

the identification of interstellar  $\text{CH}^+$  by Douglas and Herzberg a few weeks after the Yerkes conference on interstellar molecules,<sup>1</sup> last June, but there can be no doubt that the active workers in stellar spectroscopy who attended the symposium derived much valuable information and inspiration.

Although the Yerkes Observatory was officially dedicated in October, 1897 (at this occasion a conference of astronomers was held at Williams Bay, which organized the American Astronomical Society), the department of astronomy of the University of Chicago also marks its fiftieth anniversary. Exactly fifty years ago Professor George E. Hale undertook at the Kenwood Observatory in Chicago his epoch-making photographic observations of solar prominences and of flocculi on the disc of the sun. In a letter which Mr. Hale wrote in 1923, on the occasion of the twenty-fifth anniversary of the Yerkes Observatory, he described this period in the following words "... I must find a way to photograph the solar prominences without an eclipse. When this had been done at Kenwood in the autumn and winter of 1891-92, and when it appeared that a promising opportunity for progress lay in the study of the flocculi which I had found and photographed on the face of the sun, I determined that I must have a larger telescope—one that would carry powerful spectroscopes and spectroheliographs and would give a large image of the sun suitable for the study of the structure of spots, flocculi and prominences."

Apparently the idea of building a large telescope for the University of Chicago came early in 1892. Hale had been corresponding with John A. Brashear, the famous lens maker of Pittsburgh, about a 12-inch photographic objective to serve as a twin for the visual lens which he had obtained for the Kenwood Observatory. The glass had been ordered in 1891 from Mantois in France, but there were various delays in casting the disc, and on March 1, 1892, Brashear suggested that "our American friends are casting a 20-inch flat and if we carry out our wishes we will exhibit a 20-inch objective made of American glass at Chicago." Evidently, the Columbian Exposition of 1893 served as a powerful stimulus to telescope makers, as well as to astronomers! Brashear was seriously ill in the spring of 1892 and during the following summer he undertook a trip to Europe. On

<sup>1</sup> *Astrophysical Journal*, 94: p. 381, 1941.

July 5 he wrote to Hale saying that the Saint Gobain people had quoted a price of \$1 per kilo on a 30-inch disc. "Hence a 30-inch disc, 4 inches thick will cost about \$135. . . ." In September, 1892, Mr. Charles T. Yerkes agreed to finance the construction of a large telescope, and two forty-inch discs, originally made by Mantois for the University of Southern California, were purchased when it was learned that this institu-

tion would not require them. The mechanical parts of the telescope were completed by the Warner and Swasey Company of Cleveland in 1893. The great lens was tested in the optical shops of the makers—Alvan Clark and Company of Cambridgeport, Massachusetts—in October, 1895, and the first astronomical observations were made by Mr. Hale and his associates in the summer of 1897.

## OBITUARY

### WALTER GRANGER

ONE of the great paleontologists and one of the best-loved men of his generation was taken from us on September 6, 1941, when Dr. Walter Granger died suddenly at Lusk, Wyoming. As for several years past, he had gone to South Dakota to collect fossils with his old friend and colleague Albert Thomson. After attending a field conference of the Society of Vertebrate Paleontology, in the recent organization of which he was active, he was on his way back to the Big Badlands when stricken.

He was born in Middletown, Vermont, on November 7, 1872, the son of Charles H. and Ada Byron Haynes Granger. With little formal schooling, he came to New York as a boy in 1890 and obtained work as an assistant in taxidermy at the American Museum of Natural History, the institution to which he devoted all the rest of his life. His first duties, often graphically recalled, included cleaning the oil lamps along a pathway to the museum and similarly menial tasks. More interesting pursuits were bird and mammal collecting and preparation, in which he acquired permanent skill, occasionally making skins even in his last years.

In 1891 the late Henry Fairfield Osborn came to the museum to establish the Department of Vertebrate Palaeontology, and five years later, in 1896, Professor Osborn had the promising young Walter Granger transferred to this department. Here he worked as an assistant until 1909, then as an assistant curator, 1909–1911, and associate curator, 1911–1926, becoming curator of fossil mammals in 1927. In recent years and until the time of his death he was also curator of paleontology in the Department of Asiatic Exploration and Research. Without academic training, he acquired his knowledge the hard way, but so extensively and so thoroughly that he was a recognized scientific authority in his field as well as a great collector, a fact signalized not only by his rise on the scientific staff but also in 1932 by an honorary D.Sc. from Middlebury College in his native state.

Among his first expeditions was participation in the excavation of Bone Cabin Quarry, Wyoming, beginning in 1897, which resulted in the famous *Bronto-*

*saurus* skeleton and other important dinosaurian material. His first scientific publication, a joint paper with Osborn in 1901, was on this collection. In 1903 he was placed in charge of Eocene and Paleocene collecting, and he was in this field every summer from 1903 to 1906, from 1909 to 1914 and in 1916 and 1918. In these years he obtained large collections from almost every known early Tertiary formation of the West. Overshadowed in the public eye by later Asiatic collecting, this work nevertheless was and remains of the utmost importance. It laid the basis for new conceptions and more adequate knowledge of the beginning of the Age of Mammals and resulted in the most remarkable series of primitive mammal remains that has yet been assembled. From the first, and throughout his career, he was not only a collector successful in finding and skilful in preserving specimens, but also a stratigrapher of high rank. His careful observations have played an essential part in the faunal zoning and correlation of much of the Mesozoic and Cenozoic of two continents.

His first foreign expedition was to the Fayûm of Egypt under Professor Osborn in 1907. With the reorganization and expansion of the Museum's Asiatic program in 1921, he was made paleontologist of the Central Asiatic Expeditions and second in command with Roy Chapman Andrews. Aside from the main work in Mongolia, he also collected in Sze-chuan when the party was not in the Gobi. Most of his time was spent in Asia from 1921 through 1931. After 1931 he remained in charge of the preparation and study of the fossil collections of the expedition and in recent years was editor of its publications in all fields, one of the principal tasks in which he was engaged during his last months.

The superb central Asiatic collection resulted from the conjunction of an unparalleled opportunity and a man uniquely qualified to profit by it. Central Asia was the last major untouched storehouse of paleontological riches. Among the thousands of fossils collected, practically every one represented an animal hitherto unknown and vital new evidence of the pageant of ancient life. Some of these specimens are already among the most widely known of fossils: the

dinosaur eggs and the amazing series of skulls and skeletons of the dinosaurs that laid them, the tiny skulls of Mesozoic mammals, titanic *Baluchitherium*, largest of land mammals. Aside from these and other spectacular discoveries, there is case after case of teeth, jaws, skulls and skeletons, truly a whole new world resurrected from the past.

This achievement was the climax of his life, and duties in the museum, increasing with Matthew's retirement in 1927 and with Osborn's death in 1935, prevented any more major expeditions. Field work remained his greatest joy, however, and he missed no opportunity to spend a few weeks each summer working with some party in the field.

It is probably as a collector, certainly one of the greatest, that he will be best remembered in the history of paleontology, and this would be his own wish. Although less spectacular, his office researches also have permanent value. Among other independent publications, Granger completed revisions of the Eocene horses (1908) and condylarths (1915) that are still the standard works on these groups, and he also published important stratigraphic studies and a number of popular articles that excited wide interest. Collaboration with the late W. D. Matthew resulted in a long series of joint papers on Granger's discoveries in America and in Asia. He contributed to these not only the specimens and the field data but also a soundness of judgment and acuteness of perception that were, as Matthew frequently remarked, essential to the scientific value of the results. Granger was so modest regarding his intellectual achievements and he so firmly acquired the habit of communicating knowledge orally rather than in writing, that perhaps only those who worked with him realized the full extent of his acquaintance with vertebrate morphology and taxonomy. His interest in all such studies was keen and his untiring, unselfish assistance was endless and practical and could be acknowledged only over his protests.

He was a member of many scientific organizations, among them the Geological Society of America, Paleontological Society, Society of Vertebrate Paleontology, American Society of Mammalogists, American Ornithological Union, Linnaean Society of New York and Sigma Xi. Aside from his museum and his profession, his greatest interest was the Explorers Club, of which he was president in 1935-1937 and subsequently a director.

Dr. Granger's ashes will be privately buried in Vermont. A memorial service will be held at the American Museum of Natural History, probably late in October.

He is survived by his wife, Anna Dean Granger, formerly of Brooklyn, N. Y., to whom he was married on April 7, 1904, his companion at home and on many of his wide travels. They had no children.

It is thus possible to write a brief summary of the tangible facts of a noble career. Hundreds of hearts all over the world cherish the memory of intangibles that can not be well expressed in the midst of grief for their loss. Walter Granger had a talent for friendship and a zest for living, an inexhaustible store of affection that was returned on every side. Every one who knew him was happier because he lived.

G. G. SIMPSON

THE AMERICAN MUSEUM OF NATURAL HISTORY

### DEATHS AND MEMORIALS

DR. HUGH MCCORMICK SMITH, associate curator of zoology, U. S. National Museum, died suddenly on September 28. He was seventy-five years old.

PROFESSOR ARTHUR GEORGE GREEN, formerly director of research at the British Dyestuff Corporation and professor of chemistry dyestuffs at the University of Leeds, died on September 12 at the age of seventy-seven years.

THE United States Board of Geographical Names has named one of the mountain peaks in Sequoia National Park for Dr. Gustavus A. Eisen, who died in New York on October 29 of last year. Mt. Eisen is 12,000 feet high, and is part of the Great Western Divide. Dr. Eisen was born in Stockholm in 1847 and went to California in 1873. He introduced the Smyrna fig and the alligator pear to the state. In the early '70s he made expeditions through the Sierra regions and advocated the preservation of the sequoia tree. In 1890 he was the chief instrument in establishing Sequoia National Park. He was a member of the California Academy from 1874 and served as curator from 1895 to 1900.

A PLAQUE commemorating the first collegiate course in ceramic engineering was unveiled with appropriate ceremonies at the Ohio State University on September 27. The memorial will be placed on a wall of Orton Hall, adjacent to the classroom where Edward Orton, Jr., held the first collegiate classes in that subject in 1894. Fellows of the American Ceramic Society appropriated money for the plaque, and Dr. R. R. Sosman, assistant director of the research laboratories of the U. S. Steel Corporation at Kearny, N. J., presided.

## SCIENTIFIC EVENTS

### THE MATHEMATICIANS OF AMERICA AND OF SOVIET RUSSIA

THE Soviet Embassy has recently received for transmission to Soviet mathematicians a statement of solidarity signed by a number of their most distinguished American colleagues.

The document carries signatures of ninety-three mathematicians of forty-seven American universities and colleges. Professor Marston Morse, president of the American Mathematical Society, and Dr. George D. Birkhoff, Perkins professor of mathematics at Harvard University, are signers, as are eight past presidents of the society.

The statement reads as follows:

We, the undersigned mathematicians of the United States, send our greetings and express our heartfelt sympathy to our colleagues of the Soviet Union in their struggle against Hitler fascism. What the future of mathematics would be in a Hitler-dominated world we know from the unprecedented destruction of mathematics in Germany after the advent of Hitler. We are deeply impressed by the heroic stand of the Soviet peoples and know that the mathematicians of the Soviet Union are doing their part in this supreme effort.

The bonds between mathematicians in the United States and the Soviet Union are particularly strong since during the past two decades the center of world mathematics has steadily shifted to these two countries. We know many of you personally and more of you through your scientific writings. We know that you are fighting alongside your fellow countrymen in their brave struggle against the invading tyrant and we assure you that we here are doing everything in our power to aid all peoples struggling against fascism.

With best wishes for a successful fight against the evil forces of fascism, we remain, fraternally, your colleagues in the United States.

Included among the signers are the following members of the National Academy of Sciences:

Professors H. Bateman, of the California Institute of Technology; G. D. Birkhoff, of Harvard University; G. A. Bliss, of the University of Chicago; S. Lefschetz, of Princeton University; G. A. Miller, of the University of Illinois; M. Morse, of the Institute for Advanced Study; W. F. Osgood, of Harvard University; J. F. Ritt, of Columbia University; E. B. Van Vleck, of the University of Wisconsin; O. Veblen, of the Institute for Advanced Study; J. von Neumann, of the Institute for Advanced Study; J. L. Walsh, of Harvard University; N. Wiener, of the Massachusetts Institute of Technology, and E. T. Bell, of the California Institute of Technology.

### NEW TYPHUS VACCINE BEING TESTED IN BOLIVIA

AMONG the problems that health authorities keep constantly in mind is that of typhus fever, which

made such ravages during and after the last war. Recently a new vaccine against typhus fever was developed by Dr. Cox, Public Health Service, Hamilton, Montana, which it is hoped will be both effective and suitable for mass production. It has produced a high degree of immunity in laboratory animal tests, but in order to prove its efficiency, a trial must be made on large groups of people. Experiments could not be conducted in the United States because the form of typhus now present in this country is not the "European" type. The first attempts at testing the vaccine took place in the Balkans, Spain and China but were frustrated by the war. When the possibility of making these trials in one or more of the American republics came under consideration, it was decided to approach the matter through the Pan American Sanitary Bureau, the coordinating public health agency of the Americas. One of the chief functions of the bureau is the prevention of the international spread of disease, it being authorized by the Pan American Sanitary Code to undertake scientific research to this end. The bureau communicated with various Latin American countries in which louse-borne typhus is found and with the cooperation of the Bolivian authorities it was decided to send a commission to Bolivia to make a trial of the vaccine among 10,000 Bolivian Indians. In order to conduct the experiment, it is planned that half the members of every household, in the area chosen for the study, are to be vaccinated with typhus vaccine, to a total of 5,000 persons. The disease incidence in the vaccinated and the unvaccinated groups is then to be compared. In cases where the family refuses to have only half of its members vaccinated, it is thought desirable to inject the other half with the pneumococcus pneumonia vaccine, thus using the opportunity to conduct also a pneumonia study. Dr. R. E. Dyer, assistant director of the National Institute of Health, and his colleague, Dr. N. H. Topping, have been in La Paz, Bolivia, to work in cooperation with Bolivian authorities, who are giving their whole-hearted assistance. The experiment may require as long as nine months. It is possible that similar studies may be undertaken elsewhere should circumstances justify them.

### THE WARTIME SERVICE OF BIOLOGICAL ABSTRACTS

JOHN E. FLYNN, editor-in-chief of *Biological Abstracts*, University of Pennsylvania, writes that with each month of the continuance of the war diffusion of knowledge of current scientific advances becomes more and more difficult and uncertain.

When the war broke out and the blockade was imposed, the receipt by American libraries of scientific

periodicals of Germany, Italy and the invaded nations was either delayed or completely suspended. Subsequently some of this literature began to trickle through by way of Russia, Siberia and the Pacific. The outbreak of hostilities between Germany and Russia has shut off this last important means by which European publications can reach this country. Uncertain Lisbon alone is left. The scientists of Europe are likewise handicapped by the similar unavailability of scientific periodicals published in the Americas.

The abstracting journals remain almost the only means by which scientists of different nations may remain in effective contact. *Biological Abstracts* has been undertaking to compensate, so far as an abstracting journal can compensate, for this deficiency in the means of diffusing knowledge, by arranging to abstract the European literature as completely as is possible in these times. Some of our European collaborators are still active and a considerable number of current periodicals, apparently no longer available in libraries of the United States, are regularly being abstracted. Through the cooperation of the library of the Marine Biological Laboratory at Woods Hole and of the United States Department of Agriculture, special arrangements have been made for the abstracting of the foreign periodicals obtainable in these libraries. Through the courtesy of Dr. Stephen P. Duggan, director of the Institute of International Education, the cooperation of a group of Swiss biologists has been enlisted for the abstracting of German-language periodicals available in Switzerland and not in the United States. Correspondence is actively under way with biologists in the neutral nations with the aim of locating the publications in these nations and arranging for their regular abstracting.

At the present time some 1,400 periodicals are being reviewed in *Biological Abstracts*. This includes a group of about 300 periodicals, mainly European or Latin American, assigned during the course of this special drive for the better coverage of the foreign-language literature.

The editors of *Biological Abstracts* earnestly request that all biologists who are in a position to do so will aid in the abstracting of the European literature available to them. It is only by this means that, for the duration of the war, current research in biology can be brought effectively to attention. Any who are not now assisting in this way but are willing to do so are asked to communicate with Dr. Flynn.

#### CENSUS OF SCIENTIFIC AND SPECIALIZED WORKERS IN THE UNITED STATES AND IN OTHER COUNTRIES

In connection with the development of the National Roster of Scientific and Specialized Personnel, Presi-

dent Leonard Carmichael and Robert Shosteck report that it has become important to have for comparative purposes some statistical information concerning specialized personnel in countries other than the United States. From a number of points of view connected with national defense and cultural relations this information seems to be important. It will also be useful in demonstrating to American authorities the relationship between numbers of specialists and the effective defense level of various nations. Possibilities of international collaboration in the sciences may also first be determined in certain instances from such a table.

It has proved surprisingly difficult to secure information of this sort. Varied sources have been tapped to secure the incomplete data now in the Roster's file. These sources include censuses, professional directories and registries, yearbooks of various nations, professional society memberships as given in *Minerva*, and data secured by American diplomatic representatives in various nations. It is likewise recognized that some of this information may be inaccurate or somewhat out-of-date, as well as incomplete.

The data which have been compiled are available to readers of *SCIENCE*, who may obtain copies of the mimeographed report by application to the National Roster of Scientific and Specialized Personnel, Atlantic Building, Washington, D. C.

The authors will be grateful to readers of *SCIENCE* who may be in a position to amplify, correct or otherwise make suggestions concerning the preliminary tabulations contained in this report. Indications concerning the number of members in professional societies, persons registered in various professional or scientific fields, or other census figures for any particular country or professional occupation, would be acceptable. Possibly some readers may be willing to consult displaced foreign workers now in this country who may have information concerning this matter. All information in this field should be addressed to the authors at the address given above.

It must again be emphasized that the figures presented in the National Roster's tabulation are offered merely as a starting point for future corrections and additions. The data are arranged by fields for each country, and the source of all data is given on a supplementary sheet.

#### RETIREMENTS AT THE OHIO STATE UNIVERSITY

At the Ohio State University the following members of the faculty have retired with the title emeritus: Dean J. H. J. Upham, of the College of Medicine; Dr. William Lloyd Evans, chairman of the department of chemistry, and Dr. Joseph A. Leighton, chairman of the department of philosophy.

In appreciation of their work the Board of Trustees of the university passed the following resolutions:

*Of Dr. Upham:* Devoted to the maintenance and up-building of high standards in medical education and practice, his constructive career has won local, state and nation-wide recognition, as attested by his appointment to the deanship, by his former presidency of the Columbus Academy of Medicine, the Ohio State Medical Association and the American Medical Association; by his presidency-elect of the Ohio Public Health Association, and by his service as a member of the Ohio State Medical Board and of the National Board of Medical Examiners.

*Of Dr. Evans:* Beloved by students through the years as a teacher, effective, sympathetic and of contagious enthusiasm, esteemed by his faculty colleagues as one indispensable to the life and work of the university. Pro-

fessor Evans likewise shares eminence with the most distinguished research chemists of the nation. Awarded the coveted Nichols Medal of the American Chemical Society in 1929, his intensive investigations, especially in the field of the carbohydrates, have won notable commendation. His present service in the presidency of the American Chemical Society attests to leadership in his profession and signalizes a career of unusual productivity.

*Of Dr. Leighton:* Schooled in the classics, religion and philosophy, Dr. Leighton has occupied no ivory tower of recondite reflection, but has concerned himself energetically with the problems of the social order—bringing to the study of these problems, as a lecturer and teacher widely sought and as a writer widely read, the rich resources of scholarly competence and of penetrating philosophical interpretation. Dr. Leighton is a past president of the American Philosophical Association.

## SCIENTIFIC NOTES AND NEWS

DR. LUDVIG HEKTOEN, professor emeritus of pathology at the Rush Medical College and the University of Chicago, executive director of the National Advisory Cancer Council, received a citation on September 10 from the State Medical Society of Wisconsin during its annual session. This is the society's centennial award for distinguished service. The presentation was made at the annual banquet by Dr. Stephen E. Gavin, chairman of the council of the society. Dr. Hektoen was director of the John McCormick Institute for Infectious Diseases, Chicago, from 1901 to 1940.

HAVING reached the age of sixty-five years, Dr. Fred C. Koch, Frank P. Hixon distinguished service professor and chairman of the department of biochemistry of the University of Chicago, and Dr. Gilbert A. Bliss, Martin A. Ryerson distinguished service professor and chairman of the department of mathematics, retired with the title emeritus on October 1.

THE following have been appointed visiting professors at the School of Tropical Medicine at Puerto Rico: Colonel Alexander T. Cooper, U. S. A. Medical Corps, retired, military medicine; Dr. C. A. Wright, the U. S. Public Health Service, sanitary science; Dr. J. O. Dean, the U. S. Public Health Service, public health practice; Dr. David B. Dill, professor of industrial physiology, Harvard University, physiology; Dr. James A. Doull, professor of hygiene and public health, the Medical School of Western Reserve University, epidemiology; Dr. Thomas H. D. Griffiths, the U. S. Public Health Service, public health; Dr. William B. Porter, chief of medical service, the Medical College of Virginia, medicine, and Dr. William H. Taliaferro, dean of the division of the biological sciences, the University of Chicago, protozoology.

DR. WILLIAM CARSON VON GLAHN, associate professor of pathology at the College of Physicians and Surgeons of Columbia University, has been appointed professor of pathology at the College of Medicine of New York University, and has been made head of the department of pathology and laboratories at Bellevue Hospital. An agreement worked out between the city and New York University gives the university the privilege of nominating all members of the department of pathology of Bellevue Hospital and of the laboratory staff.

THE *Journal* of the American Medical Association states that Dr. Adolph Weinzirl, health officer of Portland, Ore., has been appointed director of the social hygiene fund and of a new department of public health at the Medical School of the University of Oregon, established recently by the will of the late Dr. Ellis C. Brown. Under its terms the director will spend a third of his time teaching in the university and the remainder in educational work throughout the state.

DR. FRANK D. BLOHM, of the Bangs Testing Laboratory of the Bureau of Animal Industry, has been appointed assistant professor of veterinary pathology at the Iowa State College.

GEORGE D. THORNTON, formerly assistant agronomist at the Georgia Agricultural Experiment Station, has been appointed assistant professor of soils and assistant soil microbiologist at the University of Florida. Dr. Lewis Rogers has returned to the university as associate soil biochemist after spending a year at Cornell University, where he completed the work for the doctorate in chemistry.

DR. LANCELOT HOBGEN, Regius professor of natural

history in the University of Aberdeen, has been appointed Mason professor of zoology in the University of Birmingham. He succeeds Professor H. Munro Fox.

THE Anheuser-Busch Company, St. Louis, has given to the College of Medicine of the University of Cincinnati a grant of \$30,000, in addition to \$15,000 previously given, for the promotion of research on the part played in human nutrition by the constituents of yeast. The work is carried on under the direction of Dr. Tom D. Spies, under the department of internal medicine.

AFTER more than forty-two years of service in the U. S. Department of Agriculture, Edgar Brown, principal botanist of the Bureau of Plant Industry, retired from active duty on September 30. He plans to continue his research as a collaborator.

AT the opening exercises of the eighty-third academic year of the Long Island College of Medicine, the resignation for reasons of health of Dr. Frank L. Babbott, formerly professor of pediatrics, from the office of president was announced by Henry A. Ingraham, chairman of the Board of Trustees. Dr. Babbott has accepted one of the vice-chairmanships of the College Board of Trustees and the chairmanship of the Committee on Education. Dr. Jean A. Curran, dean of the college, will continue as acting president.

DR. EDWIN H. COLPITTS, until his retirement in 1937 as vice-president of the Bell Telephone Laboratories, has become director of the Engineering Foundation to succeed the late Dr. Otis Ellis Hovey. Established in 1914 by a gift of the late Dr. Ambrose Swasey, the purpose of the Engineering Foundation is "the furtherance of research in science and engineering and the advancement in any other manner of the profession of engineering and the good of mankind."

CHARLES B. HEMMING, for fifteen years research and development chemist with E. I. du Pont de Nemours and Company, has been appointed chief chemist of the United States Plywood Corporation. He will supervise the expansion and coordination of the company's research facilities in plants throughout the country.

RICHARD O. EDGERTON, research associate at the Massachusetts Institute of Technology, has become research chemist in the Ciné Processing Department of the Eastman Kodak Company, Rochester, N. Y.

ELMORE S. PETTYJOHN, associate professor of chemical engineering of the University of Michigan, has been granted leave of absence to answer a call to active sea duty in his capacity as Lieutenant-Commander in the United States Navy. Dr. Robley C. Williams,

assistant professor of astronomy, has leave for the first semester in order that he may join the research staff of the Department of Terrestrial Magnetism in Washington to work on a defense problem.

DR. JOHN H. YOE, professor of chemistry, University of Virginia, has been commissioned a colonel in the Tennessee National Guard and aide-de-camp on the governor's staff.

BRYANT MATHER, assistant curator of mineralogy at the Field Museum of Natural History, is on leave of absence on an emergency civilian appointment under the Corps of Engineers of the U. S. Army. He will work at the Concrete Laboratory, West Point, N. Y.

MISS ALICE L. DUSTAN, formerly assistant garden editor of *The New York Times*, has become station editor at the Agricultural Experiment Station at New Haven. She will take the place of Miss K. Palmer, who has held the post at New Haven for the past seven years.

THE Registry of Dental and Oral Pathology at the U. S. Army Medical Museum has formed a circulating committee of consultants to which the more interesting and difficult cases will be sent for an opinion. The following men have been asked, and have agreed to act as consultants: Kurt H. Thoma, Harvard University; Balint Orban, Chicago College of Dental Surgery; Lester R. Cahn, Columbia University, and Hamilton B. G. Robinson, Washington University, St. Louis.

DR. WILLIAM E. LADD, professor of surgery in the Harvard Medical School, delivered on October 3 the thirteenth annual Arthur Dean Bevan Lecture of the Chicago Surgical Society at the forty-first annual dinner of the society at the University Club of Chicago. His subject was "Children's Surgery and Its Relation to the Specialties." The William E. Ladd professorship of surgery was endowed this year by a group of friends in recognition of Professor Ladd's contributions to the field of surgery for children.

DR. WALTER P. KELLEY, head of the Division of Soils of the University of California, gave two lectures at the Iowa State College on September 29. He spoke on "Soil Colloids in Relation to Agriculture" and on "The Essential Nature of the Clay Minerals and Their Relation to Soils."

MEETINGS of the American Physical Society are scheduled as follows: December 19-20, Pacific Coast meeting, Stanford University, California; December 29-31, annual meeting, Princeton; February 20-21, Detroit; April, time and place to be designated; June, Pacific Coast, time and place to be designated, and June, State College, Pennsylvania.

THE New England Conference of the American

Association of Museums will meet at Newport, R. I., on October 16, 17 and 18.

THE first of a series of meetings sponsored during the 1941-42 academic year by the New York branch of the American Association of Scientific Workers will be devoted to the subject of "Science and Civil Liberties." The speakers will be Dr. William M. Malisoff, professor of biochemistry of the Brooklyn Polytechnic Institute, and Dr. Lewis Balamuth, instructor in physics at the College of the City of New York. The meeting will be held on October 15, at 8:15 P.M., in John Jay Hall, Columbia University.

THE School of Mathematics of the Institute for Advanced Study each year allocates a small number of stipends to gifted young mathematicians and mathematical physicists to enable them to study and to do research work at Princeton. Candidates must have given evidence of ability in research comparable at least with that expected for the degree of doctor of philosophy. Blanks for application may be obtained from the School of Mathematics of the Institute, Fuld Hall, Princeton, N. J., and are returnable by February 1, 1942.

APPLICATIONS for Benjamin Peirce instructorships at Harvard University for the academic year, 1942-43, should be sent to the chairman of the department of mathematics. Candidates should have received the Ph.D. degree or have had equivalent training.

IN accordance with a Basic Science Law passed by the Legislature of the State of New Mexico in April, 1941, the State Board of Examiners in the Basic Sciences has been established, with the following personnel: *President of the Board*, Dr. John D. Clark, professor of chemistry, University of New Mexico; *Vice-president*, Dr. Fred W. Allen, New Mexico Industrial School, Springer; *Members Secretary*, Pia Marie Joerger, Office of the Secretary of State, Santa Fe; L. M. Pearsall, an osteopathic practitioner, Albuquerque; Dr. P. L. Travers, a physician and surgeon, Santa Fe; Wm. K. Wootton, a chiropractic practitioner, Albuquerque. The newly established board is to give examinations in the basic sciences on October 12, 1941, at the University of New Mexico, and there-

after each second Monday in June and each first Monday in February.

ACCORDING to *The Experiment Station Record*, the Legislature has appropriated \$2,412,900 for the support of Kansas College and the four branch stations during the current biennium. In addition to lump sum appropriations for salaries and maintenance of instruction and research, \$120,000 is appropriated for the branch stations, \$53,000 for outlying experiment fields, \$10,000 for bindweed experimental work, \$30,000 for research work on diseases of livestock, \$15,000 for milling and baking research, \$30,000 for laboratory equipment, \$15,000 for the purchase and improvement of horticultural land, \$10,000 for repairs and improvements to the physical plant of the department of animal husbandry, \$50,000 for the construction of a small animal research laboratory, \$8,000 for the purchase of land at the Colby Substation and \$200,000 for extension work. Other new items include \$30,000 for three home management houses, \$19,500 as indemnity for the fire losses of March 15 and \$30,000 for a WPA project for a military science building to cost \$125,000. Other legislation affecting the institution included a quarter-mill tax levy which is expected to raise \$600,000 per year for a building program at the five state schools, specific allocations from this fund to be made by future legislatures; an act authorizing the state schools to construct student union buildings and dormitories under a plan for ultimate repayment from fees and operating revenues, and a civil-service law covering certain non-teaching, non-research and non-administrative positions in the state schools.

THE new ligature plant of the Johnson and Johnson Company in North Brunswick, N. J., was dedicated on September 25. The new building is air-conditioned. The exterior is of Vermont marble and stainless steel, relieved by a narrow strip of plate glass skirting the sides without the usual framing. Two thirds of the space is for the processing of ligatures and there is a second building within the main building to be used for the sterilization and hermetical sealing of the processed materials.

## DISCUSSION

### THE VERTICAL DISTRIBUTION OF HEAVY MINERALS IN VIRGIN AND CULTIVATED SOILS

THE primary soil minerals may be divided into two broad groups. The first includes the so-called light minerals (specific gravity < 2.680), chief among which are quartz, orthoclase, albite and oligoclase. The second group includes the so-called heavy min-

erals (specific gravity > 2.680) of which labradorite, anorthite, augite, hornblende, muscovite, biotite and apatite may be mentioned. Minerals in the first group usually weather more slowly than those in the second group.

It has been observed frequently that the content of heavy mineral in podzol and gray-brown podsol forest soils increases with increasing depth below the

surface. The relatively low content of heavy minerals in the A horizon of soils belonging to the above zonal groups reflects the intensity of weathering to which they have been exposed.

Previous work by the writer<sup>1</sup> demonstrated that the content of heavy minerals in the upper part of forest soil bodies disturbed by the uprooting of trees was significantly higher than in adjacent undisturbed soil. This difference resulted from the translocation of material from the B or C horizons to the surface. The possibility that cultivation might similarly influence the vertical distribution of heavy minerals in soil profiles was considered.

During the summer of 1940 samples from unquestionably virgin soils and immediately adjacent cultivated soils were collected in Michigan and New Hampshire for laboratory examination. In all instances the sets of paired samples were collected from soils which seemingly differed only with respect to the cultivation factor. Miami, Colton and Hermon soil series were represented.

It has been found that the cultivated soils contain a consistently higher percentage of heavy minerals in the A horizon than do the comparable virgin soils. The results indicate that the vertical distribution of heavy minerals in the upper horizons of soil profiles may serve as an index of past agricultural use of land. This criterion may prove useful in studies concerned with the past history of land utilization. Work on the vertical distribution of heavy minerals in soil profiles is being continued and more detailed results will be published in the near future.

H. J. LUTZ

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#### REPORTING DATA ON ELECTRIC MOBILITY

RECENT interest in the electrophoresis of proteins has led to the publication of a large number of papers giving data on the speed with which proteins migrate in an electric field. Because the serum proteins near their isoelectric points move rather slowly, certain investigators expressed the electric mobilities in units of  $1 \times 10^{-3}$  cm/sec/volt/cm. However, other investigators studying ionic mobilities and the electric mobilities of microscopically visible particles have for many years expressed the electric mobilities in units of  $1 \times 10^{-4}$  cm/sec/volt/cm or its equivalent in  $\mu$ /sec/volt/cm. There does not seem to be any justification for the use of the exceptionally low mobilities of proteins near their isoelectric points as convenient reference mobilities. In view of confusion which has arisen, it would be well for the conventional unit of  $1 \times 10^{-4}$  cm or  $\mu$ /sec to be generally adopted by those

<sup>1</sup> Harold J. Lutz, *Yale University: School of Forestry, Bulletin 45*, 1940.

in the field of electrophoresis. This will serve to eliminate a good deal of future error of the type which has already arisen.

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#### ANTIDOTING TOXIN OF PHYTOPHTHORA CACTORUM AS A MEANS OF PLANT DISEASE CONTROL<sup>1</sup>

OVER forty years ago phytopathologists realized that certain fungi formed toxins which were lethal to plant protoplasm and which paved the way for the advance of the pathogenic organism through the plant tissues. *Phytophthora cactorum*, which causes a wilt disease of many plants and the bleeding canker of hardwood trees, produces such a toxin when grown on various media. Foliated, succulent excised maple and tomato shoots wilt when placed in filtrates of liquid media upon which the fungus has grown.

This toxic effect can be antidoted, that is, made inactive by the addition to the filtrate of 0.5 per cent. aqueous solution of the di-hydro-chloride salt of di-amino-azo-benzene plus a solvent and penetrant ("Helione orange"). Healthy maple trees injected with the toxic filtrate have been killed, while the same toxic filtrate to which 0.5 per cent. of the di-amino-azo-benzene salt was added failed to injure the trees.

In excess of 350 confirmed trees, naturally infected by the bleeding canker fungus, have been injected with the antidoting chemical, and have subsequently exhibited stoppage of "bleeding" and marked improvement in vegetative growth. Whether the trees have been "cured" in any absolute sense remains to be seen, but the results indicate some possibilities to be explored in the practical control of plant disease.

FRANK L. HOWARD

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#### THE FIRST MATHEMATICS SECTION OF THE NATIONAL ACADEMY OF SCIENCES

MATHEMATICAL research in the United States was started at about the time that the National Academy of Sciences was incorporated (1863) and the first important mathematical research paper published in our country was written by Benjamin Peirce who was one of the earliest members of this academy and took an active part in its early meetings. It is therefore of interest to consider briefly the qualifications of the members of the first mathematics section of this academy. Their names are J. G. Barnard, William Chauvenet, H. A. Newton, Benjamin Peirce, Theo-

<sup>1</sup> Contribution No. 599 of the Rhode Island Agricultural Experiment Station.

dore Strong and Joseph Winlock. In the year 1925 the Mathematical Association of America established a prize for the best expository paper published in English during successive periods, which is now awarded every three years and is called "The Chauvenet Prize."

The name of Chauvenet is therefore also now well known to the mathematical public of our country as an important contributor to the advancement of their subject, especially along the line of clear exposition. The remaining four names of the first mathematics section of the National Academy of Sciences are probably now less widely known among American mathematicians but they also became known internationally as results from the fact that a number of the publications of each of them are noted in the widely used periodical called *Poggendorff's Handwörterbuch*. This was started in the same year as the National Academy of Sciences and is still being continued with increasing completeness as regards advances in science in the different countries of the world.

It is interesting to note that the later developments have proved that the National Academy of Sciences selected its first mathematical members with reasonable wisdom since the merits along this line are unusually difficult to judge by those working in other scientific fields. While this Academy has served from

its beginning as an adviser of the national government along scientific lines it has wisely aimed also to encourage scientific work of high order throughout the nation by maintaining high standards for membership. By the election of a small number of "Foreign Associates" it has aimed to extend its influence beyond the borders of our own land and by including W. R. Hamilton and Michel Chasles in the first list of ten it has also exhibited wisdom along the line of mathematics in these selections.

Recently J. L. Coolidge of Harvard University published "A History of Geometric Methods" which was explicitly inspired by a work of Michel Chasles published a little over one hundred years ago (1837) but which is still widely used. This shows that some writings on the history of mathematics have been useful during a long period of time notwithstanding the fact that many more recent ones were so written that they were very soon regarded as out of date. Recently the Royal Irish Academy began the publication of the mathematical papers of W. R. Hamilton. The first volume appeared in 1931 and the second in 1940. Hence the early members of the National Academy of Sciences also made wise selections as regards the mathematical "Foreign Associates" in view of the enduring value of their works.

G. A. MILLER

UNIVERSITY OF ILLINOIS

## SCIENTIFIC BOOKS

### INFECTIOUS DISEASE

*Biological Aspects of Infectious Disease.* By F. M. BURNET, M.D., assistant director, Walter and Eliza Hall Institute, Melbourne. x + 310 pp. Illustrated. New York: The Macmillan Company; Cambridge, England: At the University Press, 1940. \$3.75.

THE dawn of bacteriology was not interested to answer the question: In what manner have the human race and the Animal Kingdom become subject to the multiform epidemization so vividly experienced in the mass mortalities during the centuries preceding the discovery of bacteria? An elucidation of the nature of the infections prevailing at that time promised results of great practical and theoretical significance. To view an infection from the standpoint of the naturalist as analogous to or identical with the biological phenomena of parasitism is an achievement of recent years. By taking an anthropocentric attitude, the student of human disease, a human being himself and trained solely in medical bacteriology, conceived the infection as a struggle between man and microbe being waged with special weapons. In the foreground of his study was placed the altered state of the host—

the disease. With the recognition of the so-called latent infections and the infections without an infectious disease, this strictly utilitarian concept was found untenable. With the realization that an infection may be studied with advantage as a branch of academic biology, it was likewise appreciated that it may be analyzed along ecological lines as a struggle for existence between man and microorganisms of the same general character as the competition between plant or animal species in nature. Those who by necessity were forced to interpret the dangers of infections, which emanate from the vast reservoir in the Animal Kingdom, fully acknowledge the guiding hand in the ecological concept of the epidemics induced by the population regulators—the microbial or virus parasites. Humble attempts to focus attention on both man and animal and on the microorganism as objects of equal interest have been made by a few authors in special monographs, but it is to the great credit of Burnet to present the teacher and, in particular, the student with a remarkable example of scientific writing and an invaluable summary on the biological aspect of infectious disease.

In 6 parts, subdivided into 15 chapters and dili-

gently, but with rare discrimination, compressed into 308 pages, the reader will find a classical condensation of every important fact and principle gathered during the past 60 years by the sciences of bacteriology, physiology, immunochemistry, epidemiology and public health. Whenever it appeared necessary, carefully selected impressive examples of disease states or epidemics are chosen to illustrate the microorganisms and their way of infection or the processes which govern their action. Every sentence incorporates one or several facts, and may on ultimate analysis review years of research and the final conclusions derived from many publications. Needless to emphasize, such a book requires slow and attentive reading in order that one may derive all the benefits of the review. Although intended to be "interesting to the layman with a taste for science," it must be admitted that even the seasoned expert and teacher will find the presentation stimulating to his memory and challenging to his intellect.

Under the heading of the "evolution of infection and defence," the genesis of parasitism is traced from the amoeba ascending to the highly developed man as a progressively increased ability to accept parasites. The elementary interaction between parasite and cell remains deeply impressed on the evolution of the defense reactions. To-day nobody will doubt the facts recognized by Metchnikoff that the phagocytic cells of the blood and of the fixed tissues are the defenders of the body. In Part II the author designates the bacteria, protozoa and viruses as the "aggressors." Perhaps it is unfortunate that this term was chosen, since it conveys the impression of a struggle between the parasite and the host being waged by special weapons—the "aggressins" of Bail. In reality it is not the power to induce disease, the so-called "pathogenicity," but the ability of the parasite to settle and to grow in living tissues, which is of biologic interest and worth detailed research. As a thorough student and pioneer in the realm of viruses, Burnet is well qualified to dissect these important enemies of life, and the methodology elaborated for their study. Concerning the biological position of viruses, he apparently favors the hypothesis that they are "the diminished descendants of pathogenic bacteria."

In Part III following a discussion of the fundamental physiologic activities of the blood and blood vessels as a part of the defenses against bacterial infections, the "wider significance of immunity," the "function and the formation of antibodies," the "species disposition" and "what makes bacteria dangerous" receives detailed consideration. According to the author, the substance which controls the permeability of the capillaries is histamine. In the light of Menkin's

studies, the nitrogenous compounds responsible for these reactions exhibit significant properties which do not resemble those of histamine. The recovery from pneumonia, the nature and function of antibodies, and the interrelation of toxin and antitoxin, as viewed by the immunochemists, are intriguing summaries and examples of fine scientific writing. One wonders what Burnet means when he says:

If in this immune reaction we have a means of transferring "reminders" to other cells, and so modifying their behavior appropriately without their having had direct experience of the appropriate stimulus, it becomes somewhat less fantastic to think that perhaps after all the sequences of altered habit, improved function and structural modification may in the long run convey some appropriate "reminder" to the reproductive cells and incorporate the change into the inheritable constitution of the species.

Acquired immunity alters the susceptibility but, as for example, in measles the descendants of resistant parents have shown for centuries a remarkably stable susceptibility and reactivity to the virus. Thus the immunity is not inherited, but the potentiality of acquiring immunity or the efficiency of the immunity mechanism is apparently dependent on constitutional factors. Concerning the harmful effects of bacteria, Burnet is not specific relative to the terminology as to what constitutes virulence and what is invasiveness. The latter depends on the surface structure of the bacteria, while the former is rather an intangible quantity which is difficult to measure. The capacity to produce a generalized deleterious effect or the so-called virulence depends on diverse poorly understood genotypic and phenotypic factors, that bacteriologists have in recent years hesitated to use the term.

The natural history of infectious disease, the "why epidemics," "how infections spread," reviewed in Part IV, considers the infection chains, the animal reservoirs, the cause of epidemic and endemic distributions, the age-incidence of disease, immunity as an epidemiological factor and the general principles of control. Part V is principally devoted to a detailed discussion of the important infectious diseases: diphtheria, influenza, tuberculosis, plague, cholera, malaria and yellow fever. The big three: influenza, plague and cholera, are treated from a historical point of view, and the latest scientific data are well analyzed. Despite the existence of different antigenic types of the influenza, Burnet hints that it might be possible to obtain "master strains" with antigenic pattern which would immunize against any but the wholly new types, such as the 1918 pandemic strain. In regard to tuberculosis, attention is called to the fact that with the isolation of patients and the diminution of frank cases an in-

creasingly large number of people will reach adult life without exposure to a tubercle bacillus infection; some sort of vaccination may have to replace the "normal childhood infection."

In a thoughtful epilogue, one is again reminded of the well-known fact that "wars, internal and external, financial depressions and labor troubles are all breeders of infectious disease. Who knows, a serious worldwide epidemic might perhaps do more to initiate a sense of genuine international cooperation." Artificial dissemination of disease as a war measure is likely to be unsuccessful, but such a weapon could be created. To combat it, Burnet believes "would re-

quire a wholly new social technique, which would bring to light as leaders men of entirely different instinctive qualities from those who now stand in authority."

This book in its handy and convenient form and with its vast store of material carefully and attractively presented is highly recommended to everybody, but in particular to all students in medicine and biology.

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## SPECIAL ARTICLES

### THE EFFECT OF 17-HYDROXYCORTICOSTERONE AND RELATED ADRENAL CORTICAL STEROIDS ON SODIUM AND CHLORIDE EXCRETION<sup>1</sup>

RECENT studies<sup>2</sup> suggested that adrenal cortical steroids with a hydroxyl group on C<sub>17</sub> induced an increased excretion of sodium and chloride in contrast to the well-known sodium and chloride "retaining-effect" of other adrenal steroids such as corticosterone and desoxycorticosterone.<sup>3</sup> For this reason a comparison has been made of the effect of a number of adrenal cortical steroids on the renal excretion of sodium and chloride in an effort to determine, if possible, the relationship of chemical structure to physiological activity. The experimental methods which have been used are similar to those which have been reported previously.<sup>3</sup>

The subcutaneous injection of 5 and 8 mg respectively of 17-hydroxycorticosterone was followed by a significant increase in the renal excretion of sodium and chloride in a normal dog (Table 1). 1 mg of this substance was ineffective in this respect. The injection of 25 mg of 11-dehydro-17-hydroxycorticosterone was followed by a striking increase in sodium and chloride excretion in both a normal dog and an adrenalectomized dog maintained on a low sodium chloride intake. In the normal dog, sodium excretion increased from a level of 10 m.eq. per day prior to treatment to 25 m.eq. on the day of therapy. In the adrenalectomized dog sodium excretion increased from a level of 10 m.eq. per day prior to treatment to 48 m.eq. on the day of therapy. In both instances chloride excretion paralleled the changes in sodium excretion. In normal rats the injection of 6 mg of 11-de-

hydro-17-hydroxycorticosterone increased the 24-hour excretion of sodium chloride by approximately 75 per cent. during the day of therapy. Potassium, nitrogen and inorganic phosphorus excretion were increased appreciably during treatment with either 17-hydroxycorticosterone or 11-dehydro-17-hydroxycorticosterone in normal and adrenalectomized dogs and rats. The relation of these changes to changes in carbohydrate metabolism have been considered.<sup>1</sup>

In contrast to the effect of these two compounds, treatment with desoxycorticosterone or corticosterone was followed by a significant retention of sodium and chloride (Table 1). Allopregnane-3,11,17,20,21-pen-

TABLE 1  
THE EFFECT OF ADRENAL CORTICAL STEROIDS ON THE RENAL EXCRETION OF SODIUM AND CHLORIDE IN NORMAL DOGS

24-hour period	Urine volume cc	Sodium m.eq.	Chloride m.eq.	Substance	Quantity mg
Control	480	56	53		
Treated	640	71	67	17-Hydroxycorticosterone	5
Control	500	50	50		
Treated	600	69	62	17-Hydroxycorticosterone	8
Control	450	54	55		
Treated	520	46	49	Corticosterone	4
Control	470	56	56		
Treated	420	29	38	Desoxycorticosterone	1
Control	530	57	59		
Treated	480	56	57	Allopregnane-3,17,20-triol	5
Control	650	57	61		
Treated	640	58	61	Allopregnane-3,11,17,20,21-pentol	5

tol and allopregnane-3,17,20-triol were found to be inactive. When 11-desoxy-17-hydroxycorticosterone is available for experimental use it will be possible to determine the physiological effect of the hydroxyl group on C<sub>17</sub> in the absence of an oxygen atom on C<sub>11</sub>. The relation of chemical structure to physiological activity is illustrated in Fig. 1.

<sup>1</sup> This study was aided by a grant from the Committee on Research in Endocrinology, National Research Council.

<sup>2</sup> G. W. Thorn, B. A. Lewis, G. F. Koepf and S. S. Dorrance, *Trans. Assoc. Am. Phys.*, 56: 1941 (in press).

<sup>3</sup> G. W. Thorn, L. L. Engel and H. Eisenberg, *Jour. Exper. Med.*, 68: 161, 1938.

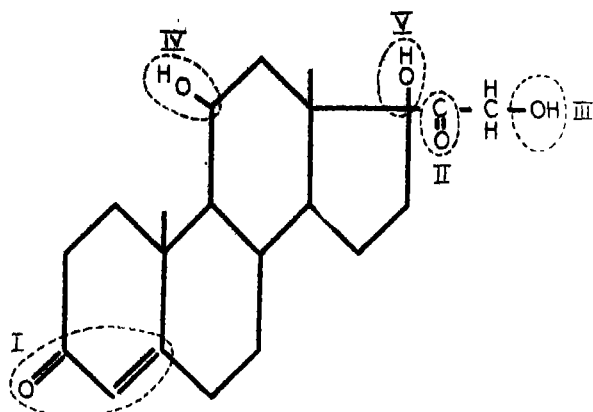


FIG. 1. I. Is essential for all known physiological activity. II. Is essential for all known physiological activity. III. Enhances sodium retention; necessary for carbohydrate activity. IV. (Either a hydroxyl or a carbonyl group.) In the presence of III, decreases sodium retention and increases carbohydrate activity. V. In the presence of III, and I & IV, increases carbohydrate activity and induces sodium excretion.

COMPOUND	STRUCTURE	EFFECT ON SODIUM AND CHLORIDE BALANCE	
		POSITIVE	NEGATIVE
DESOXYCORTICOSTERONE		++++	
CORTICOSTERONE		++	
11-DESOXY-17-HYDROXYCORTICOSTERONE			?
17-HYDROXYCORTICOSTERONE		++++	
11-DEHYDRO-17-HYDROXYCORTICOSTERONE		++++	
ALLOPREGNANE-3, 17-20 TRIOL		0	0
ALLOPREGNANE-3, 11, 17, 20, 21-PENTOL		0	0

FIG. 2

These studies help to clarify a number of controversial experimental data in regard to the effect of various cortical extracts and their derivatives on electrolyte metabolism. It is also apparent from this study why desoxycorticosterone acetate therapy, (sodium-retaining factor) in Addison's disease pro-

duces edema so readily in contrast to treatment with adequate doses of potent adrenal cortical extract which contains a mixture of "sodium-retaining" and "sodium-excreting" factors.

We are indebted to Dr. E. C. Kendall, of the Mayo Clinic, Rochester, Minnesota, and Professor T. Reichstein, of Basel, Switzerland, for the crystalline compounds used in this study.

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THE JOHNS HOPKINS UNIVERSITY  
AND HOSPITAL

### THE ENZYMATIC LINK BETWEEN DI-HYDRO-DIPHOSPHOPYRIDINE NUCLEOTIDE AND CYTOCHROME C

ALTHOUGH it has been generally held that reactions involving diphosphopyridine nucleotide (DPN) are linked to oxygen through cytochrome C, no isolated enzyme system has as yet been shown to catalyze the reduction of cytochrome C by reduced DPN (DPN · H<sub>2</sub>). Corran, Green and Straub<sup>1</sup> have suggested that heart flavoprotein performs this function, but no evidence has been presented on which such a suggestion can be based. Lockhart and Potter<sup>2</sup> demonstrated the existence in crude heart muscle extract of such an enzyme system, but the active agent was apparently not capable of being extracted in a soluble form and therefore could not be subjected to fractionation and purification. In this note we are reporting the extraction from baker's yeast of a soluble enzyme which is very active in catalyzing the reduction of cytochrome C by DPN · H<sub>2</sub>.

A spectrophotometric test similar to that used by Haas, Horecker and Hogness<sup>3</sup> in the isolation of cytochrome reductase was used. The DPN was reduced by a system consisting of hexose disphosphate, arsenate and an acetone dried enzyme powder containing zymohexase, isomerase and phosphoglyceraldehyde oxidase prepared according to the method of Warburg and Christian.<sup>4</sup> The DPN is incubated with this mixture for one-half hour at 25° and then heated for five minutes to 85° to destroy all the enzymes present. The DPN · H<sub>2</sub> is unaffected by this heating process and is stable for several days. Upon mixing an excess of DPN · H<sub>2</sub> and cytochrome C in an absorption cell,

\* John D. Archbold Fellow-in-Medicine.

<sup>1</sup> H. S. Corran, D. E. Green and F. B. Straub, *Biochem. Jour.*, 33: 793, 1939.

<sup>2</sup> E. E. Lockhart and V. B. Potter, *Jour. Biol. Chem.*, 137: 1, 1941.

<sup>3</sup> E. Haas, B. L. Horecker and T. R. Hogness, *Jour. Biol. Chem.*, 136: 747, 1940.

<sup>4</sup> O. Warburg and W. Christian, *Biochem. Zeits.*, 303: 40, 1939.

no change in the extinction at 550  $m\mu$  (a band of reduced cytochrome C) is observed. However, when 35  $\gamma$  of a partially purified enzyme preparation is added, the cytochrome C is rapidly reduced, the color of the solution changes from brown to pink, and the extinction at 550  $m\mu$  is increased. The rate of the reaction is apparently first order with respect to cytochrome C concentration, proportional to the enzyme concentration, and independent of small variations in the concentration of  $DPN \cdot H_2$ .

In Fig. 1 is shown the effect of  $DPN \cdot H_2$  on the rate

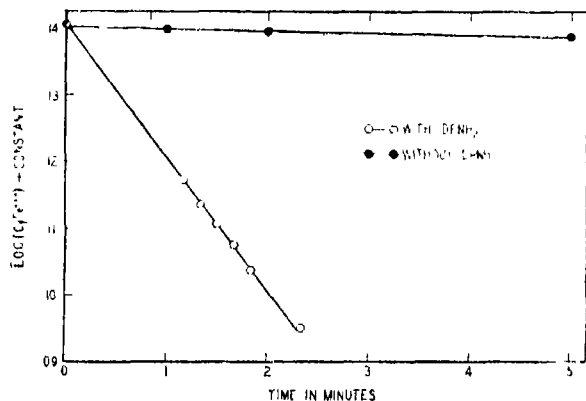


FIG. 1. Enzymatic reduction of Cytochrome C, with and without  $DPN \cdot H_2$ .

of reduction of cytochrome C by a dialyzed and somewhat purified enzyme preparation. The slopes of the straight lines shown in the drawing are directly proportional to the rate of the reduction. When  $DPN \cdot H_2$  is added to the test solution,  $5 \times 10^{-7}$  moles of cytochrome C are reduced per minute per cc of enzyme solution used. In the absence of  $DPN \cdot H_2$ , the rate of reduction is reduced to 1 per cent. of the above rate.

The activity of this enzyme can also be observed by measuring the change in absorption at 340  $m\mu$  (position of absorption band of  $DPN \cdot H_2$ ). When  $DPN \cdot H_2$  is oxidized, the light absorption at this wavelength is decreased. The results of a series of experiments are shown in Table I.

TABLE I

Experiment	cc $DPN \cdot H_2$ ( $10^{-6}$ moles/cc)	cc $DPN$ ( $2.5 \times 10^{-4}$ moles/cc)	cc Cytochrome C ( $1.5 \times 10^{-4}$ moles/cc)	cc Enzyme (20 mg./cc)	$\Delta^*$
1	0.20	...	0.05	0.05	0.212
2	0.20	...	...	0.05	0.025
3	...	0.05	0.05	0.05	0
4	0.20	...	0.05	...	0

\*  $\Delta$  is the decrease in  $\log \frac{I_0}{I_t}$  at 340  $m\mu$ , upon addition of enzyme. A 0.5 cm absorption cell was used.  $\frac{M}{40}$  phosphate buffer, pH = 7, was used to bring volume to 1.25 cc.

It is to be noted that in the absence of cytochrome

C, very little  $DPN \cdot H_2$  is oxidized, even though there is a considerable excess of  $O_2$  dissolved in the test solution. This fact would seem to indicate that this enzyme solution is far less reactive toward  $O_2$  as the oxidizing agent than cytochrome C.

This enzyme can be precipitated by ammonium sulfate, alcohol and acetone, may be dialyzed without great loss in activity and is destroyed by heating. Further work toward purification of this enzyme is in progress.

We are indebted to the Works Progress Administration, to Mr. Fred Johnson for valuable technical assistance, and particularly to the Rockefeller Foundation for a grant in aid which made this work possible.

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### FACTORS IN COCONUT MILK ESSENTIAL FOR GROWTH AND DEVELOPMENT OF VERY YOUNG DATURA EMBRYOS

IN the course of our investigations on artificial parthenogenesis it became necessary to grow embryos *in vitro* in their early stages of development. In addition, a method by which this could be accomplished might insure the success of many wide crosses hitherto impossible. Although embryos isolated from mature or nearly mature seeds have often been grown *in vitro*, no success with very young embryos has been reported in the literature.

The embryos were removed from ovules of *Datura stramonium* and transferred to a basic medium (B) containing 1 per cent. agar, 1 per cent. dextrose and a mixture of mineral salts according to Tukey.<sup>1</sup> Additional substances were added to this basic medium, as will be mentioned below. The entire procedure was carried out under aseptic conditions. In the basic medium alone, embryos approximately 2 mm long when isolated (the embryos in mature seeds are approximately 6 mm long) showed root and hypocotyl growth but no growth of the cotyledons. No viable seedlings resulted. When, however, a mixture of physiologically active substances<sup>2</sup> was added to the basic medium (BV) cotyledons developed also and viable seedlings resulted when they were kept in dim light.

Pro-embryos<sup>3</sup> and slightly older stages of develop-

<sup>1</sup> Bot. Gaz., 99: 630, 1938.

<sup>2</sup> Concentrations in mg per liter. Glycine (3), Thiamin (0.15), ascorbic acid (20), nicotinic acid (1), vitamin B<sub>6</sub> (0.2), adenine (0.2), succinic acid (25), pantothenic acid (0.5). This mixture was made up arbitrarily and because it proved effective was not further investigated as to essentiality of all components or optimum concentrations.

<sup>3</sup> Terminology follows Souèges, according to whom an embryo is called a pro-embryo as long as it remains radially symmetrical, hence, before the cotyledon primordia develop.

ment could not be grown in this medium (BV), probably because younger embryos are less capable of synthesizing their own growth factors than older ones. Coconut milk<sup>4</sup> proved to be an excellent source of these additional growth factors necessary for very young embryos. For example, results such as the following were obtained: Pro-embryos, 0.14 mm in diameter (0.00144 mm<sup>3</sup>) were isolated from ovules of 2*n* plants 14 days after pollination and transferred to media B, BV and BV to which was added non-autoclaved coconut milk, and BV to which was added autoclaved coconut milk. After 4 days in the medium containing non-autoclaved coconut milk 4 of 7 embryos were on the average 1.9 mm long and 0.6 mm in diameter. These embryos grew below the surface of the medium. Two other embryos which were placed at the surface of the medium did not grow and 1 culture was infected. Thus, the 4 embryos that had grown had within 4 days increased their volume over 300 times. After 10 days in culture the two largest of the embryos measured 10 × 1.3 mm and hence had increased in volume 8,000 times. No growth occurred in the other media.

The following is another example: 7 embryos from ovules of 4*n* plants 11 days after pollination were removed. The embryos were in a slightly more advanced stage of development than the 2*n* embryos mentioned above. They measured 0.3 mm in diameter (0.014 mm<sup>3</sup>) and showed small cotyledon primordia. After 3 days below the surface of the medium (BV) to which non-autoclaved coconut milk was added all embryos cultured had grown on the average 2.0 mm

in length and 0.9 mm in width. This corresponds to a volume increase of 90 times. After 10 days in the above medium the two largest embryos measured 8 × 1.5 mm, corresponding to a 1,000-time increase in volume. The embryos in the two experiments cited showed a good development of cotyledons and hypocotyl. The primary leaves also developed to a length almost equal to the cotyledons. Roots did not develop, but could be made to develop by transferring the embryos to medium (B) or (BV) without the additional coconut milk. A heat-stable root inhibitor which may be auxin is probably present.

In the case of these 4*n* embryos, growth also occurred in half of the cultures kept on medium (BV) to which autoclaved coconut milk was added. However, no differentiation occurred. After 10 days they had developed into lens-shaped bodies about 2 mm in diameter.

The success of coconut milk in furnishing some accessory substances which stimulate the growth of isolated embryos *in vitro* suggests its applicability to other species and prompts this preliminary report. Ultimately it is hoped to secure information regarding the nature of the substances in coconut milk which give it its peculiar properties.

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## SCIENTIFIC APPARATUS AND LABORATORY METHODS

### A MINCER ADAPTABLE TO SMALL QUANTITIES OF TISSUE<sup>1</sup>

In preparing skeletal muscle for oxygen uptake determinations we were confronted with the problem of obtaining a relatively uniform mince of small specimens obtained at biopsy. It became necessary to design and construct the apparatus described here, since we could find no adequate micromincer on the market.

The essential elements of the mincer (Fig. 1) are three telescoping parts: (1) The easily removable tubular steel jacket (A) which is held in a fixed position during mincing by a pin which fits into a slot in flange D. The mince emerges from holes drilled in the side of this tube, and the particle size can be regu-

lated by varying the diameter and number of the holes. (2) The steel knife unit (B), which is solid at the shank end and slotted, as shown, to engage with pin E, and tubular at the opposite end to accommodate the plunger, which forces the contained tissue through

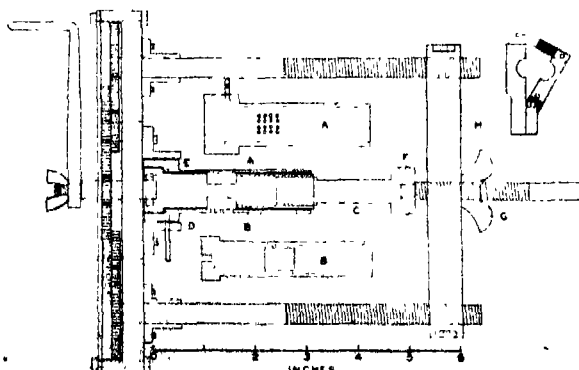


Fig. 1

<sup>4</sup> Coconuts were obtained from the local markets. The activity of the milk from different nuts varied considerably.

<sup>1</sup> Supported by the Wisconsin Alumni Research Foundation.

a square window cut into this tube immediately adjacent to the solid portion. This window is of such a size as to correspond with the area in which the holes are drilled in the outer jacket (4). The edge of the square window (or windows) is filed to form a cutting knife or knives if more than one window is made as in the larger units. This tubular knife fits snugly within the outer jacket and rotates freely when activated by the pin *E*. (3) The brass plunger (*C*) which telescopes snugly into the open end of the hollow knife is able to rotate with it since it operates freely on the bearing at *F*, thus preventing the maceration of tissues which would occur if the plunger were fixed. The outer jacket and the knife can be made more economically of seamless steel tubing fitted into brass parts to form the shank, thus reducing the amount of machine work necessary. These three mincing parts are readily interchangeable and may be removed quickly from the activating mechanism for loading and cleaning either by retracting the bearing *F* after loosening the thumbscrew *G* or by removing the supporting bar *H* from the threaded rods.

The activating mechanism is mounted on a heavy board by supporting arms attached to the gear box at such a height that the crank may be turned readily. Rotation of the knife and the advancement of the plunger occur simultaneously when the crank is turned. The two threaded rods are geared to the crank and engage the crossbar *H*. By means of this mechanism, the plunger is advanced one sixteenth of an inch for each ten turns of the knife, thus assuring the same uniform rate of tissue advancement and cutting irrespective of the speed at which the crank is turned. This is an absolute essential if a uniform particle size of tissue is to be obtained. Since the plunger can not be advanced without simultaneous operation of the knives it is impossible to squeeze tissues through the openings in the outer jacket without this material being cut, an occurrence common to the Latapie type mincer. The activating mechanism could be improved mechanically by making it possible to alter as desired the ratio of tissue advancement to knife speed. Other modifications, such as a mechanical drive and a lathe-bed type of arrangement for supporting the mincing unit, would add to the convenience but also increase the cost.

By constructing several sizes of the three essential mincing parts, all having uniform dimensions at the shank end, and by using interchangeable casings and knives, we have found it convenient to mince quantities of tissue from 0.25 to 30 grams. Dr. A. E. Axelrod, of the Department of Biochemistry, is using a small mincing unit of 4 mm plunger diameter which will deliver 200 milligrams of tissue from a 250-milligram rat heart. The efficiency of delivery is much greater

with larger units, although a small waste of tissue is inevitable because of the small dead space between the knives.

Values for  $Q_{O_2}$  obtained on tissues minced with this apparatus compare very favorably with those obtained from the larger Latapie mincer. This mincer will cut soft tissues like brain or liver into discrete particles. Dr. V. R. Potter<sup>2</sup> has found that this apparatus yields a liver mince of "the critical particle size needed to permit adequate inward diffusion of oxygen with minimum loss of cytochrome due to outward diffusion." Fibrous mammary tumors, cartilage and even soft bone, which are refractory to mincing with the Latapie or simple pressure mincers, are reduced readily in the apparatus as described.

The mechanical features were designed by J. S. Hipple, Medical School mechanician, who also constructed the apparatus.

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#### A COMBINED FIXATIVE AND STAIN FOR THE CILIA AND TRICHO CYSTS OF PARAMECIUM

THE combined fixative and stain described here offers numerous advantages over the methods now used for the demonstration of trichocysts and cilia. The structures are stained instantaneously and the normal contour of the animals is faithfully preserved. The trichocyst stain is prepared as follows: Copper sulphate, 5 per cent., 50 cc; hydrochloric acid, 0.1N, 12 drops; blue ink, 5 drops.

If it is desired to stain the cilia only, the hydrochloric acid is omitted from the formula. To use the stain, add two drops to the culture on the slide, place cover glass and examine. The best preparations are usually found around the edges.

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<sup>2</sup> V. R. Potter, *Jour. Biol. Chem.* (in press).

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## THE CHICAGO MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Edited by Dr. F. R. MOULTON

PERMANENT SECRETARY

FROM September 22 to September 27, inclusive, the American Association for the Advancement of Science had the pleasure of participating in the Fiftieth Anniversary Celebration of The University of Chicago. This was the one hundred ninth meeting of the association and its fifth meeting in Chicago, earlier meetings having been held in that city in 1868, 1908, 1920 and 1933. The program of the meeting consisted largely of the "Fiftieth Anniversary Symposia" on "New Frontiers in Education and Research" which were organized by the university. However, the Section on Medical Sciences (N) presented a very comprehensive and distinguished symposium on "Aero-

biology," which had been in preparation for more than a year. There were, in addition, twelve special lectures by distinguished scholars, on many of whom honorary degrees were conferred at the convocation of the university held on September 29.<sup>1</sup>

Although at the time of the Chicago meeting most universities had already entered on the work of the current academic year, the attendance was gratifying and the participants were distinguished. About 2,000 persons were registered, and probably many others attended one or more of the sessions without registering. In quality, the meeting was worthy of a great

<sup>1</sup> SCIENCE, October 8, p. 321.

university. The fine buildings provided ample accommodations and the arrangements for the convenience of visitors were excellent. Nearly all the contributors to the programs submitted copies of their addresses far enough in advance to permit their being mimeographed for the use of representatives of the press, who were assigned commodious quarters in Mitchell Tower. To those who remembered the debris-littered grounds of earlier days the green, well-kept campus was a delight. In its maturity the university has taken on the genteel mellowness characteristic of all famous seats of learning, but it has lost much of the crusading spirit that for a generation led the Middle West and the South into a myriad of new educational adventures.

The date of the celebration was so late that several affiliated societies of the association were compelled for various reasons to hold their meetings earlier. The American Mathematical Society, the Mathematical Association of America, the Institute of Mathematical Physics and the Econometric Society held meetings at the university during the week beginning on September 1. On September 7-9 the American Astronomical Society held its annual meeting at the Yerkes Observatory, following which the astronomers held a three-day symposium on "Astronomical Spectra."

#### SPECIAL LECTURES

On September 3, 4 and 5, Professor Oystein Ore, of Yale University, delivered the twenty-third colloquium lectures of the American Mathematical Society on "Mathematical Relations and Structures." It is expected that the society will publish these lectures.

On the evening of September 3 the sixteenth Josiah Willard Gibbs lecture was delivered by Sewall Wright, The University of Chicago, on "Statistical Genetics and Evolution."

On Monday, September 22, Herald R. Cox, Rocky Mountain Laboratory, U. S. Public Health Service, recipient of the Theobald Smith Award in Medical Sciences of the A.A.A.S. for 1941, delivered an address on "Cultivation of Rickettsiae of the Rocky Mountain Spotted Fever, Typhus and Q Fever Groups in the Embryonic Tissues of Developing Chickens." The award consists of one thousand dollars and a bronze medal furnished by Eli Lilly and Company. In his address Dr. Cox explained his important method of producing vaccines for a group of very serious diseases by inoculating fertile eggs of hens with their causative viruses. His method is relatively simple, inexpensive and is adaptable to quantity production.

In his introductory remarks, Dr. Langmuir, president of the association, alluded to the coincidence that Dr. Cox was awarded a prize for his development of a vaccine for rickettsial diseases, which were named

after Dr. Howard Ricketts, a former member of the faculty of The University of Chicago, who discovered their causative agents. He recalled the fact that Dr. Ricketts died of the disease following an accidental infection while studying it in Mexico City in 1910.

On Monday, September 22, Robert R. Williams, chemical director, the Bell Telephone Laboratories, delivered an address on "The Social Implications of Vitamins."

On Tuesday, September 23, Donald Dexter Van Slyke, chief chemist, The Rockefeller Foundation for Medical Research, lectured on "The Physiology of Amino Acids."

On Wednesday, September 24, Lydia J. Roberts, chairman of the Department of Home Economics, The University of Chicago, delivered a lecture on "Textile Research in the Interest of the Consumer."

On Thursday, September 25, Florence Barbara Seibert, professor of biochemistry, The Henry Phipps Institute, University of Pennsylvania, delivered an address on "Tuberculosis as the Chemist Sees It."

On Thursday, September 25, Isabel Maitland Stewart, professor of nursing education, Teachers College, Columbia University, delivered a lecture on "Advancing Frontiers in Nursing Education."

On Thursday, September 25, Halvdan Koht, formerly professor of history, Royal Frederick University, Oslo, and formerly Secretary of State of Norway, delivered a lecture on "The Historical Interpretation of Art and Literature."

On Thursday, September 25, Reginald Aldworth Daly, Sturgis-Hooper professor of geology, Harvard University, delivered an address on "Glaciation and Submarine Valleys."

On Friday, September 26, Charles Herbert Best, professor of physiology, University of Toronto, delivered an address on "The Significance of Choline as a Dietary Factor."

On Friday, September 26, Ernest William Goodpasture, professor of pathology, Vanderbilt University, and vice-president of the A.A.A.S. for the Section on Medical Sciences (N), delivered an address on "Virus Infection of the Mammalian Foetus."

#### SYMPOSIA

Thirty-three symposia were presented on a wide variety of subjects, ranging from pure mathematics to the place of ethics in social science. The titles of nearly all of them and the names of the contributors to them were listed in the August 15 issue of *SCIENCE*. An exception was an extensive symposium on Aerobiology, which was presented at five sessions and which consisted of thirty-seven papers.

The symposium on Aerobiology was organized by the Section on the Medical Sciences, of which Dr.

Malcolm H. Soule is secretary, in cooperation with the Committee on Aerobiology of the National Research Council. Dr. E. C. Stakman was largely responsible for organizing the part of the symposium on extramural aerobiology and Dr. Stuart Mudd for the part on intramural biology.

The first session was devoted to eight papers on extramural aerobiology. Such subjects were discussed as "Air-borne Pollens as Allergens," "Air-borne Fungus Spores as Allergens" and "Long Distance Dissemination of Plant Pathogens."

The remainder of the program, consisting of twenty-nine papers, was devoted to problems of intramural aerobiology, including such subjects as "Air-borne Infection as a Basis for a Theory of Contagion" and "Disinfection of Air by Air-conditioning Processes." The third session was devoted entirely to papers on various aspects of "The Germicidal Action of Ultra-violet Light." The fourth and fifth sessions continued with reports of experiments, and of experiences in hospitals and other institutions, on the control of respiratory contagions by the use of ultra-violet radiation and other means.

It is expected that the symposium on Aerobiology will be published by the association.

A symposium on "Life at High Altitudes and Aviation Medicine" attracted special attention because two of its papers combined important scientific problems with matters of human interest. Professor Carlos Monge, of Lima, Peru, read a paper on "Life upon the Andes and Chronic Mountain Sickness," in which he discussed the effects of seasonal migrations from high plateaus to low levels, a change resulting in a reduction of atmospheric pressure by as much as 40 per cent. Naturally the radical change in important factors of the environment calls for corresponding physiological adjustments which Dr. Monge had investigated. For example, he reported on experiments on the reproductive capacity of various domestic animals when transported to high altitudes. In spite of the fact that domestic animals taken to high altitudes failed to reproduce themselves, the native inhabitants, both human and animal, at the same altitudes have the same birth rates as in low altitudes. It is reported that the Spanish Conquerors had no offspring until fifty years after they founded Potosi, at an altitude of 14,000 feet.

In a paper on "The Physiology of a Free Flight through the Air," Dr. A. C. Ivy and his associates reported on free falls from airplanes by A. H. Starnes through distances ranging from 8,400 feet to 16,500 feet before the opening of his parachute. With the aid of a large amount of auxiliary apparatus carried by Mr. Starnes in his leaps records were secured of

the physiological and psychological effects on the parachutist. The apparatus for determining the orientation of the subject showed that he often gyrated or tumbled rapidly before his parachute opened. The experiments showed that during the period of free fall he suffered no appreciable unfavorable effects on heart rate, blood pressure, vision, hearing or mental alertness. The greatest falling speed attained in a drop of 16,500 feet was 158 miles per hour, appreciably below the flying speed of transport planes and much below the speed of combat planes. Consequently the shock on the jumper when the parachute opens is reduced by delaying its opening, and the danger of becoming entangled with his plane and from enemy fire is also reduced.

Surface chemistry has recently become a subject of great interest to both chemists and biologists—to the former, because in this field chemists deal with the chemical properties of matter under the relatively simple conditions when it is in layers one molecule or a few molecules thick; to the latter, because on a knowledge of the properties of the surface layers of living cells depends the understanding of many of the most important life processes. Primarily for this reason a symposium on "Surface Chemistry" was organized. A second reason for its organization was the fact that Dr. W. D. Harkins, of the University of Chicago, was a pioneer in this field and the program was partly in his honor. The symposium, consisting of eleven papers, was presented at three sessions. One of the contributors to it was Dr. Irving Langmuir, president of the association. It is expected that the association will publish this symposium.

#### MEETING OF THE EXECUTIVE COMMITTEE

On September 21, the day before the beginning of the programs of the meeting, the executive committee held an all-day session. Most of its actions were in the nature of recommendations to be presented to the council at the annual meeting, which will begin on December 29 in Dallas, Texas. There were, however, a few that from their nature were immediately effective.

1. Dr. Lewis H. Weed and Dr. Edward Harvey Cushing were appointed representatives of the association at a meeting of the Division for the Social and International Relations of Science of the British Association for the Advancement of Science, which was held in London from September 26 to 28, 1941. J. G. Winant, Ambassador from the United States to Great Britain, was chairman of the session for discussions of "Science and Human Needs."

2. The Permanent Secretary was authorized to send a cable of greetings to the divisional meeting of the British Association.

3. Dr. Raymond J. Seeger, of George Washington University, Washington, D. C., was elected secretary of the Section on Historical and Philological Sciences to succeed Dr. C. A. Browne, resigned, for the term which will expire at the close of the annual meeting in December-January, 1944-45.

4. It was voted to accept the invitation from the University of Michigan to hold a meeting in Ann Arbor, June 22-26, 1942.

5. It was voted to meet in Atlantic City in December, 1944, and in St. Louis in December, 1945, provided satisfactory arrangements for the meetings can be made.

6. The executive committee considered with favor the suggestion that, provided satisfactory arrangements can be made, summer meetings be held as follows: New Haven, 1943; Madison, 1944; Chapel Hill-Durham, 1945; Toronto, 1946.

## ORIGIN AND IDEALS OF THE NATIONAL SCIENCE FUND<sup>1</sup>

By Dr. ALBERT F. BLAKESLEE

CARNEGIE INSTITUTION OF WASHINGTON, DEPARTMENT OF GENETICS, COLD SPRING HARBOR, N. Y.

I HAVE been asked to say a few words about how the idea of a national science fund got started and what the committee has done which was appointed to study the desirability of establishing such a fund. It should be emphasized at the start that no one person originates an idea entirely alone; there are always others who contribute. Although I happened to be the one who suggested a national fund for science along the lines of our present organization I was merely expressing what seemed a logical need from a background of the experience of many. Perhaps the most important contributing event was the two-day symposium organized by the American Philosophical Society on February 19 and 20, 1937, on "Administering Funds in Aid of Research" in which I was privileged to take part as a delegate of the Carnegie Institution of Washington. The late Dr. E. M. East, who also attended the symposium, visited us on his way back to Harvard. We naturally talked over the problems which had been raised in the meeting and he told of his experience as chairman of a committee of the American Academy of Arts and Sciences on their "Permanent Science Fund." The name fascinated me and later I began to wonder if there could not be established a fund which would be more national in character and which might perform a service not ade-

quately cared for by any organization. In our discussions with East we had lamented the fact that those who make donations in support of science so frequently fail to investigate the likelihood of scientific dividends from their donations, although they might exercise great care when financial dividends were involved. An example of unwise generosity was presented at about this time when a local estate was offered as a clinic for a particular method of cancer treatment which later was found unable to stand up under critical tests of the medical profession.

The fund I had in mind might be of service, I felt, to possible philanthropists in preventing such an example as that just given and serve as a clearing-house of information on philanthropic investments in science. I tried the idea out on a number of people, including a friend in the Central Hanover Bank and Trust Company, who turned me over to their department of philanthropy. They seemed to think the idea had possibilities of service and showed me two booklets they had just gotten out giving the opportunities for philanthropy in the fine arts and in public health. They believed there was an opportunity for similar service in pointing out the opportunities for philanthropy in science. When told of the various scientific organizations in the country, both state and national, that might organize such a fund, they felt that the National Academy of Sciences would be the best because of its national character and its select membership. The pamphlets from the Central Hanover Bank and Trust Company, together with other information and suggestions which I had assembled regarding a possible national science fund, were turned over to Dr. Lillie, as president of the National Academy of Sciences, at the spring meeting of the academy in 1937. Later in the year I woke up to find myself a member of a committee of the academy to investigate the feasibility of a national science fund.

It soon became evident that our committee was not

<sup>1</sup> Remarks at first meeting of Board of Directors of National Science Fund at University Club, New York City, May 21, 1941. The newly appointed Directors of the Fund are: R. Adams, W. W. Aldrich, *Vice Chairman*, J. B. Angell, J. F. Bell, A. F. Blakeslee, I. Bowman, A. H. Compton, J. B. Conant, E. G. Conklin, J. W. Davis, L. P. Eisenhart, H. L. Ferguson, H. S. Gasser, W. S. Gifford, C. J. H. Hayes, H. Hoover, E. O. Lawrence, F. R. Lillie, R. A. Millikan, A. MacLeish, H. S. Mudd, A. N. Richards, W. J. Robbins, *Chairman*, E. Root, Jr., H. Shapley, T. K. Smith, L. L. Strauss, H. H. Swift, G. H. Whipple. *Ex officio*: The President, National Academy of Sciences, F. B. Jewett; The Treasurer, National Academy of Sciences, J. C. Hunsaker, *treasurer*; The Chairman, National Research Council, R. G. Harrison; The President, American Association for the Advancement of Science, I. Langmuir; H. H. Sargeant, *Executive Secretary*.

interested in any intensive drive for money in support of research but rather in the establishment of a fund on such a basis that through the years it would be of service both to philanthropists who wished to make investments in promotion of scientific discoveries and to those capable of carrying on research. Through grants from the Carnegie Corporation it has been possible to secure the services of an executive officer, Mr. H. H. Sargeant, who has made a thorough study of the whole field of endowments in this country and the place that might be filled by a national science fund. It comes out very clearly that since the depression began the financial support of fundamental research has been decreasing, especially in the universities. With the war abroad and the defense program in this country fundamental research has suffered still more. A successful national science fund which could preserve and advance fundamental research would seem especially needed therefore at the present time.

Little need be said about the activities of the committee on organization since our recommendations are incorporated in the constitution of the new National Science Fund. I should like, however, to say a few words regarding what I believe should be the ideals of the National Science Fund.

The original idea of the fund was not a scheme to raise money for a particular group, *i.e.*, the scientists, but rather to offer service that was not adequately cared for. I believe this ideal of service should be at the basis of all the fund's activities. This service can be considered in three main aspects: (1) service to donors; (2) service to scientists; and (3) service to humanity.

(1) *Service to Donors*: In stressing the service which it may render to donors, the fund may become rather a unique organization. Gifts to science, as any other philanthropies for the promotion of human welfare, should be considered as investments. The National Science Fund may become a clearing-house for advice on the probable scientific dividends which may be expected from investments in science. For such advice the National Science Fund has available the members of the National Academy of Sciences and can call upon the membership of the two closely associated organizations, the National Research Council and the American Association for the Advancement of Science each of which is represented *ex officio* on our board of directors. For donors who wish to have this done, the National Science Fund is in position to receive donations and administer funds in support of science. The character especially of the lay members of the fund should assure the financial integrity of such funds and the character especially of the scientific members should assure a scientifically profitable use

of such funds. Donations to the National Science Fund should become named funds with some such title as the "John Doe Science Investment" and should be enduring memorials with continuing service. This opportunity should be open to those donors who have only small amounts to give to science as well as to the benefactors of larger means who wish to put their benefactions where their administration will continue to have the best scientific advice humanly procurable.

(2) *Service to Scientists*: While the first service may be to the donor in guiding him in his efforts to promote the welfare of mankind through the advancement of science, the National Science Fund can be of direct service to scientists. Grants committees and endowments for the promotion of science depend too largely upon applications for grants in their allotments in support of science. This is the easiest way. I believe the National Science Fund can be most successful in increasing the yield of scientific dividends from the funds at its disposal if it seeks out the skilled investigator rather than making grants solely to those who apply. Such a scheme would tend toward the more just award of real merit. Men differ greatly in their capacities for research. A great problem in the advancement of science is how to devise a scheme for discovering the exceptional abilities at an early age and giving men with such abilities exceptional opportunities for the expression of their talents. The National Science Fund can act as a clearing-house for exceptional ability among scientists as well as for advice to donors.

(3) *Service to humanity*: The interest of philanthropists is probably not in science as an end in itself but rather in the promotion of human welfare through the advancement of science. Much could be said of the material benefits brought about by science in the way of human comforts, alleviation of suffering and the rise in the standard of living from the applications of scientific discoveries. Modern civilization is truly the product of science. Though it has brought us material comforts, its greatest gift is an unshackling of the human mind from the bondage of ignorance and superstition. It is the increased knowledge of the world in which we live and the spiritual values of science that should be emphasized. Like art, music and literature, science nourishes the spirit. A wholly new world would be born if the ideals of science should become universal. The National Science Fund may help to spread the methods of science more widely and to help society reach judgments on the basis of ascertained fact rather than through emotional appeal and personal profit. There is a service which science has to offer to society and it is in relation to this service

in large measure that the lay members of our board have been chosen. They are in better position to judge regarding the incidence of science upon human welfare than the scientific members of the board, who are perhaps too closely involved in scientific activities.

I have all confidence that in the years to come the National Science Fund will fulfil a needed service both to those of philanthropic intent and to the scientists, and through these two groups to the welfare of mankind.

## OBITUARY

### CHARLES BRANCH WILSON

October 20, 1861–August 18, 1941

THE unexpected, yet quiet passing of Dr. Charles Branch Wilson, of Westfield, Massachusetts, in the early hours of the eighteenth of August was a profound shock to all of us who knew him personally and a grievous loss to the science of marine biology that we shall probably not see made good in our lifetime, and perhaps not in several lifetimes to come.

In his comprehensive knowledge of the free-swimming marine and parasitic copepods, which comprised his more specialized field of study, Dr. Wilson was without a peer. He was one of the last of that outstanding, more or less contemporary group of the great monographers of the marine copepods which included such famous men as George Stewart Brady, James Dwight Dana, Wilhelm Giesbrecht, George Ossian Sars and Thomas and Andrew Scott (father and son, respectively).

From 1896 to 1932 Dr. Wilson was head of the science department of the State Teachers College at Westfield, where he carried on many of his researches. It is to the everlasting credit of the college and those connected with its administration that he was permitted to continue in his laboratory there from the time of his retirement in 1932 until his death. Without those congenial and studious surroundings of which he was so intimate a part perhaps the three great works of his later, retired years, still in manuscript form, but complete and now awaiting publication at the U. S. National Museum and the Carnegie Institution of Washington, might never have been accomplished.

The first of these manuscripts, and perhaps the most important in Dr. Wilson's own opinion, deals with the copepods of the marine plankton taken on the last cruise of the ill-fated non-magnetic yacht, *Carnegie*. This report, which was submitted for publication several years ago, for the first time in the history of oceanography gives the directly comparable results of simultaneous three-level tows made in all oceans with identical gear, accompanied by full station data, including temperature, salinity, density, phosphates and hydrogen ion concentration. In his painstaking tabulation of the species of copepods in every haul and their abundance at each of the three levels investigated, involving the microscopic inspection of many thousands of individual copepods, Dr. Wilson has

made available a biologic record of a group of organisms of highest importance in the economy of the seas such as has never been achieved by any marine expedition.

The second of these manuscripts completes the study of the last remaining unidentified parasitic copepods in the national collections, describing 6 new genera and 15 new species. Through the almost unaided efforts of Dr. Wilson, the National Museum now possesses the most comprehensive collection of parasitic copepods in the world.

The third and last of these manuscripts sets forth the results of his study of the copepods of the plankton and dredged material amassed during the greater part of the useful life of the former U. S. Fisheries Steamer *Albatross*. In time this covers nearly a quarter of a century, from 1887, when the *Albatross* made her memorable passage from the Atlantic to the Pacific by way of the Straits of Magellan, to 1910, which marked the close of the three-year *Albatross* Philippine Expedition. This monumental report makes important additions to the records of distribution of 469 species of copepods, describes 32 new species, and describes the hitherto unknown opposite sex of twenty-eight.

Dr. Wilson was active to the very eve of his death. Scarcely twenty-four hours before his passing I had the great pleasure of visiting him. At that time he went over with me some of the work that he was engaged in at the moment, pointing out some of the high lights in these manuscripts and showing me his very complete notes and records of the known species of copepods and the incomparable library of copepod literature that he had built up in the course of a busy lifetime.

Just five days later it became my sad duty to represent the Smithsonian Institution at his funeral. Had I not gone to Westfield for that ceremony I might never have learned how universally well known and beloved Dr. Wilson was by all the townspeople and by all those who ever attended his classes at the college, how varied his interests, how full his life and how much he furthered, and I may say fathered, the educational and social life of the community in which he spent the greater part of his life. His service as a member of the school committee was the longest in the town's annals. He was a devoted churchman.

having given long-to-be-remembered lay sermons or lectures, and was a founder of the town's Get-together Club. He was a most able bowler and a proficient golfer in his day, and was keenly interested in basketball, baseball and, in fact, all outdoor sports. One is amazed to learn that he had time for all these things in addition to his many researches which have given Westfield and its State Teachers College an enviable reputation as a scientific center.

Nine different countries have published one or more of his scientific writings, which comprise not less than 85 titles. Besides copepods, his publications include the results of original researches on the embryology of amphibia, sipunculid and nemertean worms; life histories and economic importance of dragon-flies, damselflies, aquatic hemiptera and coleoptera, and freshwater mussels; as well as the results of various biological surveys made chiefly by the U. S. Bureau of Fisheries (now Fish and Wildlife Service) and several school texts and outlines.

Never hurried, he accomplished a prodigious amount of work, and all of it showed evidence of most meticu-

lous care. His manuscripts required as little editorial attention as any ever to be submitted to the National Museum for publication. In this connection, Dr. S. F. Hildebrand recalls an incident at the time when Dr. Robert C. Coker was director of the U. S. Fisheries Station at Fairport, Iowa. On receipt of a manuscript from Dr. Wilson, Dr. Coker called the staff together, in order to show them the manuscript as an example of how a report should be written and how a manuscript should be prepared for publication, so well and beautifully was it done.

Dr. Wilson was one of the most valued scientific collaborators on the rolls of the National Museum. He bequeathed to the museum his library of copepod literature, which is perhaps the most complete of its kind in the world, together with his correspondingly complete card catalogue of copepod names in literature and references to the species dealt with by each author represented in his library.

WALDO L. SCHMITT

U. S. NATIONAL MUSEUM

## SCIENTIFIC EVENTS

### CHEMICAL RESEARCH ACTIVITY

A DECREASE of twelve per cent. in the world's recorded chemical research activity for the first half of 1941 as compared with the first half of 1940 is reported by Professor E. J. Crane, of the Ohio State University, editor of *Chemical Abstracts*, to the American Chemical Society.

The United States produces even in peacetime more than a quarter of the world's output of scientific and technical papers announcing new chemical information. It has as yet shown no noticeable decrease in the publication of the results of research for peacetime purposes.

Although the effects of the present warfare between Germany and the Soviet Republic are not reflected in the figures, the U.S.S.R., like the United States, up to the present has more than held its own. The British and German scientific and technical periodicals, in which a good many chemical papers of the peaceful-purpose type are still being published, average about half their regular size with rather wide variation among individual journals.

Abstracts gathered by systematic examination of more than 3,500 scientific, technical or trade journals published in thirty-one languages and obtained from all corners of the earth, and of the patent literature, number approximately 65,000 in a normal year. The twelve per cent. decrease in the past year may be compared with a drop of ten per cent. in abstracts of papers published in 1940 from the number for 1939.

Professor Crane points out:

The reporting of research activity naturally lags behind performance so that war effects will no doubt become increasingly evident. Even so, a decrease of not more than one fifth in peaceful chemical research activity the world over can be safely predicted for war-torn 1941 from the output of the virtually peaceful year 1939. Is that not somewhat surprising?

There has probably not been a great deal of falling off in chemical research considered on the basis of total accomplishment the world over. In such conquered spots as France and Poland there is little or no opportunity or incentive for research. On the other hand, research activity conducted for national purposes and not reflected by publication is obviously in high gear in the countries still at war and in those preparing for the possibility of warfare.

Wide-awake nations recognize the value of their scientific men and they are not putting them in the field. Even so, so-called "all-out" warfare and preparedness, with so many important nations involved, has come very far from killing off chemical research for peaceful purposes. American scientific periodicals remain "fat." Paper shortage is no doubt a factor in the reduction of European journals.

### ALASKAN EXPEDITION OF THE AMERICAN MUSEUM OF NATURAL HISTORY

DR. HARRY L. SHAPIRO, associate curator of physical anthropology of the American Museum of Natural History, has returned after working during the summer at Point Hope, Alaska.

Further light has been thrown on the discoveries made in 1939 and 1940 by an American Museum-University of Alaska expedition under the direction of Dr. Froelich G. Rainey, which found remains of a prehistoric town on the ancient migration route from Asia to America. Differences in the color of the vegetation disclosed five long avenues of some 600 buried dwellings that probably housed 3,000 people on the barren gravel spit of Point Hope, 130 miles above the Arctic Circle. Subsequent excavations in the graves that led out from the town site uncovered remains and implements very different from those of the prehistoric and present-day Eskimo tribes of that region. This ancient culture has been labeled "Ipiutak" from the Eskimo name of a small spit of land near the site.

In log-walled tombs, constructed in rectangular shape, well-preserved skeletons were found with their implements. Skulls were equipped with large ivory eyeballs, inlaid with jet pupils, and fantastic ivory carvings evidently used for decoration. The graves also contained many arrowheads, fine flint tools, needles and other artifacts of daily living. The carvings and implements made by these people were sufficiently different from the known Eskimo cultures to encourage further search to trace its origin.

Dr. Shapiro collected skeletal remains of the Ipiutaks as well as of the more recent Eskimo tribes and studied the living populations of Point Hope and the interior in order to determine the relationship of the ancient Ipiutak people to their successors. Another site excavated was at Tigara, a village very near the ancient Ipiutak town, now inhabited by modern Eskimos who live by hunting whales, seals and other sea mammals. Excavations at Tigara showed that it had been occupied since the abandonment of the Ipiutak site, roughly about 2,000 years ago. The Ipiutak culture is especially distinguished by a unique ivory art, an abundance of finely chipped flat tools and by an emphasis on land hunting gear. Many implements widely distributed among all previously known Eskimo people are absent. Moreover, in certain respects the Ipiutak culture, although the oldest in the area, is more complex and developed.

Dr. Shapiro made one of the largest collections of skeletal remains from any site in the New World, comprising 500 skeletons and covering more than 2,000 years of occupation in the Point Hope region. The results of months of laboratory work in measuring and comparing the remains from all these sites will determine the relationship of the Ipiutaks in the history of human migration from Asia to the North American continent.

Five hundred tombs were excavated by the expedition in an area covering an extent of six miles leading out from the Ipiutak town. The great number of

artifacts recently found will be added to the collection made last year. One of the most interesting discoveries is a carved ivory mask made in several sections, with the inset ivory eyes which are peculiar to the Ipiutak burials. The mask was found in a tomb enclosing the remains of a man, a woman and a child. The body of the child was resting on the knees of the man and the huge ivory mask covered the body of the child. The significance of this and other Ipiutak burials is unknown.

### THE ENGINEERS' DEFENSE BOARD

IN view of the existing national emergency, six national engineering societies have joined to organize the Engineers' Defense Board in order to provide a central agency that will be prepared to assist the various branches of the government with engineering knowledge and experience on questions connected with military preparedness. Among the functions of this organization will be:

To serve as a channel to inform engineers generally regarding defense problems, especially those involving shortages of materials.

To implement and make applicable reports and recommendations of the advisory committees of the National Academy of Sciences.

To urge engineers (a) to adopt procedures looking toward accomplishment of the objective of defense agencies; (b) to promote means of increasing production of raw materials in which shortages exist; (c) to conserve the supply of industrial materials; (d) to find substitutes, and (e) to simplify operations and production.

To act as a clearing house between engineers or engineering groups of information regarding substitute materials, waste prevention and conservation.

To appoint, on request of the Army, Navy or other defense agency, special committees of engineers to deal with specific engineering problems related to defense.

To select problems or projects dealing with defense and to study them with due regard to activities of existing agencies.

For the purpose of organization, the Engineers' Defense Board will consist initially of five representatives from each of the following six national engineering societies (American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, American Society of Mechanical Engineers, American Institute of Electrical Engineers, Society of Automotive Engineers and American Institute of Chemical Engineers) such representatives to be appointed by the governing bodies of such societies. To these may be added one or more representatives of such other national engineering societies as may be invited to participate by the Executive Committee of the Engineers' Defense Board, such representatives to be designated by the governing body of their re-

spective society; and such additional representatives of the six "organizing" societies as may be requested by the Executive Committee of the Engineers' Defense Board.

The activities of the Engineers' Defense Board will be administered by an Executive Committee consisting of (a) a chairman, a vice-chairman and a secretary, elected by the other members of the Executive Committee and (b) one representative of each of the six societies heretofore named, appointed by the governing body of their respective societies. The officers need not be representatives of any of the participating societies.

#### THE MONTHLY SCIENCE NEWS OF THE BRITISH COUNCIL

THE British Council has formed a Science Committee under the chairmanship of Sir William Bragg, director of the Royal Institution, with the object of strengthening relations between British scientific men and those abroad, and to encourage mutual understanding of their problems and achievements.

The other members of the committee are Professor P. M. S. Blackett, the first to photograph the artificial disintegration of an atom; Professor J. D. Cockcroft, who first disintegrated atoms by machinery; Sir Robert Robinson, the eminent chemist who has contributed to the knowledge of natural coloring matters, among other groups of substances; Dr. C. F. A. Pantin, who has made studies of the movements of *Amoeba*; Sir Edward Mellanby, known for his work on vitamins A and D; Rear-Admiral Gordon Gordon-Taylor, a surgeon; Sir William Larke, a leading engineer; Sir Edward Appleton, an authority on radio waves and discoverer of new conducting layers in the higher atmosphere; Dr. A. P. M. Fleming, director of research of the Vickers Electrical Company; C. D. le Maistre, an authority on engineering standards, and Professor R. V. Southwell, a designer of aircraft structures and investigator of the theory of elasticity.

The committee has begun the publication of the *Monthly Science News* letter, giving a survey of current scientific developments under the editorship of J. G. Crowther, the secretary of the committee, science writer, author of "British Scientists of the Nineteenth Century," "The Social Relations of Science" and other books on general science.

#### THE CONTRIBUTION OF HARVARD UNIVERSITY TO NATIONAL DEFENSE

ACCORDING to *The Harvard Alumni Bulletin* President Conant has been spending two days a week in Washington during the summer as chairman of the National Defense Research Committee and expects to continue on approximately the same schedule during

the winter. Many members of the faculty are engaged in part-time service on a variety of defense duties, and a number of others have been relieved from university duties to respond to the call of the government. A number of these, particularly from the scientific departments or the Schools of Medicine and Public Health, are engaged in laboratories in Cambridge, or elsewhere, on confidential work.

Among those on full-time duty on defense activities away from the university are: K. T. Bainbridge, associate professor of physics, Massachusetts Institute of Technology; R. H. Cole, instructor in physics, Navy Yard, Washington, D. C.; E. M. Purcell, faculty instructor in physics, Radiation Laboratory, Massachusetts Institute of Technology; T. E. Sterne, lecturer on astrophysics, 1st Lieutenant, Aberdeen Proving Ground, Maryland; J. C. Street, associate professor of physics, Massachusetts Institute of Technology; D. B. Dill, professor of industrial physiology and consulting physiologist to the Department of Hygiene, Major, Aero-Medical Research Unit, Wright Field, Dayton, Ohio; H. H. Aiken, associate professor of applied mathematics and faculty instructor in physics and communication engineering, Lieutenant Commander, U. S. N. R., Naval Mine Warfare School, Yorktown, Va.; J. P. Den Hartog, associate professor of applied mechanics; Lieutenant Commander, U. S. N. R., Bureau of Ships, Navy Department, Washington, D. C.

#### THE HUNDRED AND SEVENTY-FIFTH ANNIVERSARY OF THE FOUNDING OF RUTGERS UNIVERSITY

THE hundred and seventy-fifth anniversary of the founding of Rutgers University was celebrated on October 8, 9 and 10. The celebration opened with an address by Dr. Roscoe Pound, from 1915 to 1936 dean of the Harvard Law School, who was from 1892 to 1903 director of the Nebraska Botanical Survey. He was followed by Dr. Karl T. Compton, president of the Massachusetts Institute of Technology.

A number of symposia were held in the afternoon. Dr. Vannevar Bush, president of the Carnegie Institution of Washington, and Robert W. Trullinger, of the U. S. Department of Agriculture, took part in the symposium on applied science. Governor Charles Edison was the principal speaker at the New Jersey dinner on October 9.

Dr. Hugh Stott Taylor, of Princeton University, presided on Friday when Dr. Irving Langmuir, of the General Electric Company, and Professor E. O. Lawrence, of the University of California, took part. President Clarence Dykstra, of the University of Wisconsin, made an address on Saturday.

Among the honorary degrees conferred at the anniversary convocation on October 11 were the following:

*The honorary degree of Doctor of Laws:* W. H. S. Demarest, president of Rutgers from 1905 to 1925; Roscoe Pound, of the Harvard Law School; Clement Clarence Williams, president of Lehigh University, and Charles Howard McIlwain, Eaton professor of the science of government, Harvard University.

*The honorary degree of Doctor of Science:* Irving Langmuir, The General Electric Company, Nobel Laureate in chemistry in 1932; Ernest Orlando Lawrence,

director of the Radiation Laboratory, University of California, Nobel Laureate in physics in 1939, and Hugh Stott Taylor, chairman of the department of chemistry, Princeton University.

*The honorary degree of Doctor of Engineering:* Karl Taylor Compton, president of the Massachusetts Institute of Technology, and Robert William Trullinger, agricultural engineer in the Office of Experiment Stations, United States Department of Agriculture.

## SCIENTIFIC NOTES AND NEWS

At the annual Founder's Day convocation at Lehigh University, presided over by President C. C. Williams, the honorary degree of doctor of engineering was conferred on Henry Sylvester Jacoby, emeritus professor of bridge engineering, Cornell University; on Thomas R. Leighton, director, University of Chile School of Engineering; on J. Smith Miller, senior vice-president, Dravo Corporation of Pittsburgh; on Igor I. Sikorsky, St. Petersburg Naval College, '06, airplane designer, and on Abram F. Steckel, inventor and engineer. The honorary degree of doctor of science was conferred on Dr. Harvey E. Jordan, dean of the University of Virginia Medical School, and the honorary degree of doctor of laws on Roland G. D. Richardson, dean of the Brown University Graduate School. The ceremonies marked the opening of the exercises celebrating the seventy-fifth anniversary of the university.

MRS. PAUL EHRLICH, widow of the great German pathologist, was presented with a \$1,000 check at a dinner held in commemoration of the thirtieth anniversary of the discovery of salvarsan. The dinner was held by the American Social Hygiene Association at the Waldorf-Astoria, New York, on October 11, two months after the arrival of Mrs. Ehrlich as a refugee from Germany. Dr. Thomas Parran, Surgeon-General of the United States Public Health Service, said at the dinner: "Dr. Ehrlich's many contributions to the advancement of medicine placed him with Pasteur, Lister and Koch among the immortals of medicine."

A DINNER in honor of Dr. Eugene F. DuBois, head of the department of physiology and biophysics at the Cornell University Medical College, was given on October 9 at the Waldorf-Astoria by his former associates of the department of medicine and the New York Hospital. Dr. Malcolm Goodridge, president of the New York Academy of Medicine, presided. Brief speeches reviewing Dr. DuBois's contributions to medicine were made by Dr. Herbert S. Gasser, director of the Rockefeller Institute for Medical Research; by Captain E. W. Brown, U. S. Navy Medical Corps; by Dr. Soma Weiss, professor of the theory and practice of physics at the Harvard Medical School; by Dr.

Lewis A. Conner, professor of clinical medicine, and Dr. Constance Friess, instructor in medicine at Cornell University, and by Dr. David P. Barr, who succeeds Dr. DuBois as physician-in-chief of the New York Hospital and head of the department of medicine.

PRESENTATION of the Rumford Award by the American Academy of Arts and Sciences on October 8 was made at the annual meeting of the academy to Dr. Vladimir K. Zworykin, associate director of RCA Laboratories, specifically in recognition of his work in the development of the RCA electron microscope.

DR. LEONHARD STEJNEGER, head curator of the department of biology of the U. S. National Museum, distinguished for his work in herpetology and ornithology, will reach his ninetieth birthday on October 30.

THE retirement is announced of Dr. Ernest N. Pattee, professor of chemistry at Syracuse University. Dr. Pattee joined the faculty of the university as instructor in 1890.

DR. L. D. WOOSTER, for thirty years head of the department of biology and geology at the Kansas State Teachers College at Fort Hays and during the past two years dean of the undergraduate division, has been appointed president of the college.

CURTIS L. WILSON, professor and head of the department of metallurgy at the Montana School of Mines, has been appointed dean of the Missouri School of Mines and Metallurgy at Rolla, Mo.

DR. JOHN D. STEWART, of the surgical staff of the Massachusetts General Hospital and of the Harvard Medical School, has been appointed full-time surgeon-in-chief of the Edward J. Meyer Memorial Hospital at Buffalo, N. Y., and professor of surgery in the Medical School of the University of Buffalo.

DR. DONALD H. McLAUGHLIN, professor of mining geology at Harvard University since 1934, a member of the faculty since 1925, has been appointed dean of the Colleges of Engineering and Mining at the University of California at Berkeley.

DR. HARRY A. OBERHELMAN, associate clinical professor of surgery at Rush Medical College, Chicago, senior attending surgeon at Presbyterian Hospital, has been appointed chairman of the department of surgery at the School of Medicine of Loyola University, Chicago. He succeeds Dr. Louis D. Moorhead, who resigned recently to devote his time to private practice.

At Purdue University G. Bryant Bachman has been appointed to a professorship in chemistry.

DR. HILTON A. SMITH, of the department of chemistry at Lehigh University, has become professor of chemistry at the University of Tennessee.

THE *Journal* of the American Medical Association reports that Dr. Derek E. Deuny-Brown, London, has taken up his work as professor of neurology at the Harvard Medical School and director of the neurologic unit at the Boston City Hospital. His appointment dates from September, 1939, but during the interval he has been on leave of absence serving as a major in the British Royal Army Medical Corps. The British War Office has now released him from military obligations for an indefinite period, during which he retains his commission in the reserve.

DR. KARL FREDERICK MATTIL, of the department of agricultural and biological chemistry of the Pennsylvania State College, has joined the research staff of the department of chemistry of the University of Pittsburgh.

DR. C. L. PEIRCE, radiologist-in-chief at the Royal Victoria Hospital, and Dr. W. L. Ritchie, director of radiology at the Montreal General Hospital, will direct a department of radiology that has recently been established in the medical faculty at McGill University.

DR. SHARAT K. ROY, curator of geology at the Field Museum of Natural History, Chicago, has returned from an expedition to study fossil deposits in the western and northern regions of New York State. He brought back various groups of invertebrate fossils, chiefly from the upper and middle Devonian periods.

DR. W. G. BURROUGHS, head of the department of geology and geography of Berta College, who has leave of absence, has been visiting places of geologic and geographic interest in the Canadian provinces and New England. Dr. G. D. Hubbard, emeritus professor of Oberlin College, is conducting Dr. Burroughs's classes during his absence. He will return to his work on November 8.

DR. WALTER H. VOSKUIL, mineral economist and head of the Section of Mineral Economics of the Illinois State Geological Survey, has been granted two

months' leave of absence to join the Office of Price Administration in Washington, where he will organize the Coal Division.

THE Gehrman Lectures of the College of Medicine at Chicago of the University of Illinois will be delivered on October 20, 21 and 22 by Major Harry G. Armstrong, of the Medical Division of the United States Air Corps School of Aviation Medicine at Randolph Field, Texas. The titles of the individual lectures are: "Medicine in Aviation"; "Selection and Care of Fliers," and "Effects of Flight on Man."

DR. H. KEFFER HARTLINE, associate professor of biophysics of the Johnson Research Foundation of the University of Pennsylvania, will deliver the first Harvey Society Lecture of the current series at the New York Academy of Medicine on October 30. He will speak on: "Nervous Activity and Visual Mechanisms."

DR. FRANCIS W. REICHELDERFER, chief of the U. S. Weather Bureau, will deliver on October 15 an address entitled "Some Famous Weather Maps" before a joint meeting of the Washington Academy of Sciences, the Washington Philosophical Society and the Washington Society of Engineers.

DR. C. H. BEHRE, JR., who was recently called from Northwestern University to a professorship of geology at Columbia University, gave on October 6 an illustrated address entitled "The Origin of South Park, Colorado," before the section of geology and mineralogy of the New York Academy of Sciences.

DR. JOHN P. PETERS, of the Yale University School of Medicine, will address an open meeting of the Philadelphia Branch of the American Association of Scientific Workers on "Social Reorganization in Medicine in the Interest of Science." The meeting will be on Friday, October 24, 8:15 P.M., at Houston Hall, University of Pennsylvania.

THE Indiana Academy of Science will hold its fifty-seventh annual winter meeting on October 30 and 31 and November 1 at Greencastle, Indiana, with DePauw University as host. The Junior Academy, composed of forty high-school science clubs, will meet on November 1. Dr. Paul Weatherwax, of Indiana University, will preside over the meeting.

A JOINT meeting of three of the founder societies of the Institute of Physics, namely, the Acoustical Society of America, the Optical Society of America and the Society of Rheology, will be held on October 24 and 25 at the Hotel Pennsylvania, New York City. Symposia have been arranged by each society and a joint luncheon of the three societies will be held on Friday noon at which the speaker will be Dr. Vanne-

var Bush, president of the Carnegie Institution of Washington and director of the Office of Scientific Research and Development.

THE meeting of the Philosophical Society of Washington on October 11 was devoted to the eclipse expedition of 1940 of the National Geographic Society and the National Bureau of Standards. The titles and authors of the papers presented were: "The Design and Construction of Eclipse Apparatus," by Dr. Irvine C. Gardner, of the National Bureau of Standards, "Contact Times of the 1940 Eclipse, Determined from Photographs of the Partial Phases," by Paul A. McNally, S.J., of Georgetown University; "Sky Brightness at Patos, Brazil, during Twilight and during the Total Solar Eclipse of 1940," by Dr. E. O. Hulburt, of the Naval Research Laboratory; "The 1940 Flash Spectrum," by Dr. C. C. Kiess, of the National Bureau of Standards (by invitation); "Radio Observations of the Ionosphere at the 1940 Eclipse in Brazil," by Theodore R. Gilliland, of the National Bureau of Standards (by invitation), and "The Story of the Expedition in Colored Motion Pictures," by R. H. Stewart (by invitation).

THE first seminar for Teachers of the History of Pharmacy was held at Madison, Wis., on July 28 and 29, under the auspices of the American Institute of the History of Pharmacy. It is intended to make this an annual feature of the institute. Special periods of the history of pharmacy and their teaching will be made the subjects of seminars, the individual topics being assigned in so far as possible to specialists in the fields concerned. Dr. Arthur H. Uhl, director of the department of pharmacy of the University of Wisconsin, president of the institute, assigned the task of determining the place and the general topic of the

next seminar to a committee consisting of Drs. R. D. Bienfang, E. J. Ireland, C. O. Lee, *chairman*, Minnie M. Meyer and Dr. George Urdang.

*The Harvard Alumni Bulletin* reports that during the summer the work of the Harvard Public Health Unit and of the American Red Cross-Harvard Hospital, under the direction of Dr. John E. Gordon, of the Harvard Medical School, assisted by many other appointees of the staff, has proceeded rapidly. On September 22, the hospital, outside the old cathedral town of Salisbury, was formally opened to patients and the admission buildings and one ward became available. In addition to these, the laboratory is now completed and ready for research work, which has been going on since mid-January. The hospital will consist of 22 units in all, with accommodations for 126 patients—including laundry, laboratory, kitchen and quarters for the personnel. The buildings occupy an area of approximately fifteen acres.

AN Associated Press dispatch states that the Fish and Wildlife Service has apportioned \$2,530,000 among the forty-eight states for restoration of wildlife under the Pittman-Robertson act. The Federal Government pays 75 per cent. of the cost of projects and the states 25 per cent. With the state contributions, the wildlife work will cost \$3,373,333. The largest appropriation was allotted to Michigan, which will receive \$143,946. Texas was second, with \$132,716; Pennsylvania, third, \$130,083; New York, fourth, \$120,204, and California, fifth, \$111,800. Apportionments are based on the number of licensed hunters and the area of each state. The service reported that two states, Georgia and Nevada, had failed to adopt cooperative legislation and could not obtain the apportionment funds until they did.

## DISCUSSION

### THE ZOOLOGICAL MUSEUM AT TRING

ZOOLOGY in Britain has been fortunate in enlisting the interests of men who not only possessed wealth, but were themselves keen students of animal life. The *Biologia Centrali-Americana*, issued by Godman and Salvin, contributed enormously to our knowledge of the life of the lands south of us, though of course incomplete in the light of what we know to-day. At Tring, in Hertfordshire, Lionel Walter, Lord Rothschild, founded a splendid museum, devoted principally to birds and Lepidoptera. I visited it several years ago, and was shown over the place by Dr. K. Jordan, who works on fleas and certain beetles, as well as Lepidoptera, and is one of the keenest entomologists of his time. I was amazed at the collections and the elegant way in which they were displayed; thus the

drawers of butterflies have glass below as well as above, so that one only has to turn the drawer over to see the undersides of the wings. The arrangements for study, with perfect lighting, are also very noticeable, so that when Dr. Jordan said I should be welcome to work there, I regretted that circumstances would make this impossible, and that moreover the collections did not include the subjects of my studies.

Then there came a time when the Tring Museum was the occasion of serious criticism. There had been a sort of tacit understanding that the great collection of birds would some day go to the British Museum, which had in fact neglected to secure various species which were known to be at Tring. Rothschild, for financial reasons, decided that he must sell his study collection of birds, and without even giving the British

Museum a chance to bid on it, disposed of the whole to the American Museum in New York. If it had to go abroad, there was certainly no place so suitable, and recent publications show how valuable it has been to American students. In the collection were the type specimens of a number of subspecies of birds peculiar to the British Islands, their description resulting from the critical (some would say hair-splitting) studies of recent times. The authorities of the American Museum, to the gratification of all concerned, presented these British specimens to the British Museum.

In spite of these causes of discontent, Lord Rothschild, who came to greatly regret having parted with the birds, wished to associate himself with the British Museum, and when he died, willed the whole institution to that Museum, to be kept up as a research center for zoologists. There was some discussion as to the acceptance of this gift, with its necessary obligations, but most zoologists warmly supported the proposal and the trustees took on the Tring Museum as a branch of the British Museum of Natural History. The advantages are many. There are the buildings and the great collections, with excellent facilities for work. The situation, distant from London, avoids the dreadful fogs of the metropolis, and (as was not then thought of) the danger from enemy bombs. It is possible, at Tring, to work in peace, without the innumerable interruptions which are unavoidable at the British Museum. Thus the place is a veritable haven of refuge and will undoubtedly contribute more and more to zoological science.

In Rothschild's day, it was found difficult or impossible to publish the numerous papers resulting from the work of the museum in the ordinary scientific journals. There was accordingly established a periodical called *Novitates Zoologicae*, which has now reached the forty-second volume. I am glad to see that the British Museum is keeping this going, and a bulky part of 180 pages, dated October, 1940, is now before me. It consists entirely of a monographic revision of the Mexican water beetles of the family Elmidae, by Dr. H. E. Hinton, of the British Museum. It must be admitted that not many of us are vitally interested in Mexican water beetles, as such, but the work is of wider value than its title would suggest. For example, Hinton has specially investigated the internal anatomy of his beetles, something an entomologist hardly ever does. He finds that the internal organs throw considerable light on taxonomic problems. Thus the genus *Cylloepus* is found to consist of two very distinct groups, which are treated as different genera. The beetles, without dissection, are easily separated by the presence or absence of a certain patch of tomentum, but ordinarily this would not be thought of as a generic character. The larvae are

also described at considerable length, and the larval characters contribute to the system of classification. There is an interesting discussion of the problem of description. It is pointed out that it is impracticable and undesirable to enumerate all the characters of an insect, but at the other extreme, too short descriptions, even if they suffice to separate the insects from other known species, may fail utterly when numerous new species are discovered. Thus there has to be a middle-of-the-road policy, and the successful describer is he who knows his group, and can judge of the characters likely to prove important. The Mexican Elmidae have been so little known that all the species seen by Hinton have been described by two men only, 14 by Dr. David Sharp and 23 by Hinton. Many more undoubtedly remain to be discovered.

T. D. A. COCKERELL

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### ALCAPTONURIA IN A NEGRO FAMILY

ALCAPTONURIA is an outward manifestation of a very rare anomaly of protein metabolism in which homogentisic acid is excreted in the urine. This defect in body chemistry is hereditary and appears to be a rare recessive character in the Mendelian sense. Its mode of incidence is remarkably similar to that of albinism. Its presence, however, is not as strikingly apparent as is that condition. The error in metabolism is present from birth and persists throughout life.<sup>1</sup>

Comparatively few instances of alcaptonuria have been reported in this country. Of approximately 122 cases in the literature in 1929, only 17 occurred in the United States, the majority having been reported from European countries.<sup>2</sup> At the present time only 21 of the total number of recorded cases were reported in this country. As the condition is most often recognized by accident, undoubtedly more alcaptonurias exist than the records show.

Alcaptonuria in the American Negro has never been reported. We know that albinism exists among Negroes. Nothing, however, is known of the existence in this race of the other, less obvious, inborn errors of metabolism.

It is the purpose of this article to report the occurrence of alcaptonuria in two children of a Negro family. Fig. 1 is a diagram of the members of the family investigated. None but the two children was affected. The girl (D), 8 years old, was recognized during a routine examination in the out-patient clinic as a probable alcaptonuric from the atypical reduction of Benedict's solution given by her urine. On

<sup>1</sup> A. E. Garrod, "Inborn Errors of Metabolism," 2nd Edition, London, 1923.

<sup>2</sup> E. S. Bagnall, *New Eng. Jour. Med.*, 201: 422, 1929.

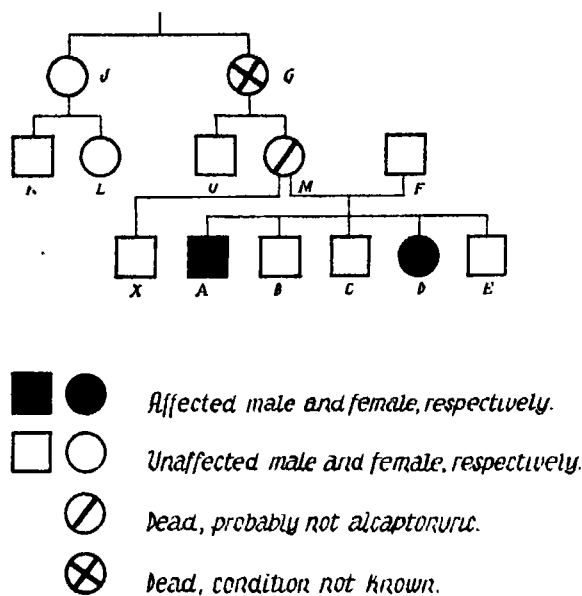


FIG. 1

examination, the urine was found to give the reactions characteristic of homogentisic acid: addition of 10 per cent. sodium hydroxide resulted in a brownish-black ring at the surface which gradually penetrated downward, ferric chloride caused a transitory blue color with each drop, and reduction of silver lactate and of ammoniacal silver nitrate proceeded rapidly at room temperature. The urine, as excreted, was amber, clear and acid. Quantitative analyses showed a concentration of homogentisic acid (Briggs's method<sup>3</sup>) in a random sample of 5 gm per liter with a homogentisic acid to nitrogen (H:N) ratio of 53.5:100. A larger sample, used for isolation of homogentisic acid, contained 4.4 gm per liter, and the H:N ratio was 45.1:100.

Investigation of the girl's four brothers revealed the fact that her eldest brother (A), 13 years old, also was excreting homogentisic acid. Qualitative tests were positive. The H:N ratio of a sample was 48.3:100. These ratios agree well with those given in the literature. The qualitative tests were confirmed by actual isolation of homogentisic acid from the lead salt obtained from the urine of both children.

The father (F) is not an alcaptonuric. Negative tests for urinary sugar on the mother (M), who died in the hospital in 1935, are considered evidence of the absence of any reducing substance in her urine. She probably was not alcaptonuric. The children's parents (F and M) were not related. The half-brother (X), 17 years old, the offspring of a previous marriage of the mother, is not an alcaptonuric. This would be expected if the error is a simple recessive character. It recalls the very interesting case of two

alcaptonurics, brother and sister, whose parents later married others and had children, none of whom showed alcaptonuria.<sup>4</sup> The father's relatives are all in the Carolinas and thus unavailable for examination. The mother's brother (U) is not alcaptonuric. Unfortunately, the grandmother of the children (G) died one week before this study was undertaken. Whether or not she may have been alcaptonuric is not known. The grandmother's sister (J) and her children (K and L) are not alcaptonuric.

The two children (A) and (D) appear healthy and well nourished. They are typical American Negroes in every respect. That they have been alcaptonuric since infancy is attested by the fact that the father well recalls the staining of the bedding caused by the urine of these two children.

## SUMMARY

A report of the occurrence of alcaptonuria in two children of a Negro family is presented. Other members of the family were investigated and found to be unaffected. This is the first evidence that this inborn error of metabolism exists in the American Negro.

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DEPARTMENT OF BIOCHEMISTRY,  
MEDICAL COLLEGE OF VIRGINIA, RICHMOND

## HUMAN GENE SYMBOLS

In no field of science is there greater lack of uniformity with respect to the usage of symbols and greater lack of adherence to conventional genetic rules than in the field of human genetics. For instance one finds in recent human genetic literature the statement, "the three allelomorphous blood group genes A, B, and R," and the statement, "the blood group alleles M and N." Such usages lack logic and clarity and are not in accordance with generally accepted genetic rules.

For a long time it has been the custom in dealing with the genetics of lower forms to give all members of a given allelomorphous series the same basic symbol and to distinguish one member of a series from another by capitalization or by a superscript. For instance, the piebald alleles of the house mouse are designated as S and s, and the albino allelomorphous series of guinea pig coat color genes are designated as C, c<sup>h</sup>, c<sup>d</sup>, c<sup>r</sup>, c<sup>a</sup>. These same rules should be applied to all human alleles.

To indicate the genes responsible for the presence or absence of isoagglutinogens A and B and for the M and N agglutinogens the writer has used the following symbols: I<sup>A</sup>—isoagglutininogen A; I<sup>B</sup>—isoagglutininogen B; i—absence of A or B; A<sup>m</sup>—agglutininogen M; A<sup>n</sup>—agglutininogen N.

<sup>3</sup> A. P. Briggs, *Jour. Biol. Chem.*, 51: 453, 1922.

<sup>4</sup> A. E. Garrod, *Lancet*, 2: 1616, 1902.

These symbols seem appropriate and in agreement with general rules, and since, as far as the writer is aware, no other sets of blood group symbols have been generally employed, he suggests that the above symbols be considered for general usage.

Perhaps the time is ripe for the establishment of a committee or an organization of some kind to formulate rules for an international system of human gene symbols. However, the current international situation does not make this seem feasible at the present time. A less ambitious program is to attempt agreement among investigators in this country. If this were achieved, much would have been accomplished.

HERLUF H. STRANDSKOV

UNIVERSITY OF CHICAGO

### FEEDING BEHAVIOR OF A WATER SNAKE

ON June 4, 1941, in a swamp a mile northwest of Voorheesville, N. Y., I witnessed an interesting feeding procedure of the common water snake *Natrix s. sipedon* (Linnaeus). As I walked along the railroad tracks, at this point elevated about eight feet above the floor of the swamp, my attention was directed to a disturbance of the water in an isolated, shallow, muddy pool approximately two feet in diameter, 3 to

4 inches deep and about 25 feet distance. Cause for the disturbance was a water snake about three feet long. After partially concealing myself behind the base of an electric signal tower, I continued to view the proceedings from that vantage point—part of the time aided by 8× binoculars.

At short intervals the active reptile coiled, writhed and twisted its body vigorously as it moved round and round in the little pool, thus agitating the water but making no effort to leave the area. After a few seconds of this violent exertion it suddenly became quiet, usually with its head directed toward the periphery of the pool. Occasionally the snake crawled slowly about in the water apparently on the alert for small living forms that might have been dislodged from the bottom by its movements. Frequently the reptile struck at something in the debris surrounding its feeding place. This performance was repeated several times within the space of 20 minutes.

To the observer the energetic aquatic activities of the snake appeared to be *deliberate* and *purposeful* in that they served to free small animal forms from the mud and debris at least some of which fell prey to the reptile.

DAYTON STONER

NEW YORK STATE MUSEUM

## SCIENTIFIC BOOKS

### CHEMISTRY

*A Practical Survey of Chemistry.* By WALTER S. DYER. vii + 480 pp. 107 figs. New York: Henry Holt and Company. 1941. \$2.80.

COLLEGE science has for many generations largely confined itself to exhaustive formalized courses in specific fields. Fundamental courses of this sort will always be required for training the specialist. Of late, however, there has arisen a demand for general scientific knowledge by the layman who never intends to specialize but who wishes to acquire an intelligent comprehension of scientific principles and facts.

One indication that this challenge is being recognized and answered is evidenced by the General Education Series of books, of which "*A Practical Survey of Chemistry*" is a new member. Dr. Malcolm S. MacLean, of Hampton Institute, and well known for his creative work as past director of the General College of the University of Minnesota, is editor of this series. In his preface to Dr. Dyer's text he states: "It is one of the first books in the field of the physical sciences in general education which offers a sound basis to the student. It will have the effect of diminishing the blindness and resistance of nonscience students to this study."

This book represents an excellent balance between theory and practice. The applications of chemistry to daily experience are so frequently and clearly presented throughout all the chapters as to make its perusal intensely interesting, even to the casual reader. Interest is further enhanced by the large and excellent selection of half-tones and line drawings. Yet fundamental chemical theory is introduced in support and explanation of facts. Certain chapters, such as those on the classification of the elements and atomic structure, are of necessity largely theoretical.

Dr. Dyer has skillfully chosen and coordinated his topics, ranging from the gas laws and the elements to plastics, foods and hormones. He supplements each chapter with a summary, review questions and a bibliography. Very recent developments of the science have not been overlooked.

In the effort to be practical scientific accuracy is occasionally sacrificed. We read of candy turning to sugar; of boiling an egg in a saturated solution of sugar; of the query "Why does a mixture of salt and ice get cold?" One wonders in reading the text to what extent it was sired by the pioneer book of Timm—once termed a pandemic text. Many of the cuts are taken from Timm. Frequently the order of subject-

matter closely follows that book. In a few cases the wording is identical.

"A Practical Survey of Chemistry" will find ready acceptance with teachers who must stress the cultural side of chemistry, and to such Dr. Dyer has made a timely and valuable contribution.

R. W. GETCHELL

IOWA STATE TEACHERS COLLEGE

*Fundamental Chemistry.* By HORACE G. DEMING. xviii + 756 pp. Illustrated. New York: John Wiley and Sons; London: Chapman and Hall. 1940. \$3.50.

AN interestingly different text-book, in which general chemistry is carefully boiled down to elementary principles, with minimum attention to descriptive, industrial and cultural aspects. Written for the inquisitive student.

HUBERT N. ALYEA

PRINCETON UNIVERSITY

*General College Chemistry.* By JOSEPH A. BABOR and ALEXANDER LEHRMAN. xiv + 659 pp., 151 figs. Thomas Y. Crowell Company, New York City, 1940, price \$3.75.

*Introductory College Chemistry.* By JOSEPH A. BABOR and ALEXANDER LEHRMAN. xiii + 663 pp., 138 figs. Thomas Y. Crowell Company, New York City, 1941, price \$3.50.

GENERAL COLLEGE CHEMISTRY is designed primarily for students who have had high-school chemistry, whereas "Introductory College Chemistry" (this book replaces "Elements of General Chemistry," by Babor, Estabrooke and Lehrman) is designed for two types of courses: (1) courses composed for students who have had high-school chemistry and (2) courses in which no differentiation between students is made on the basis of high-school preparation.

Frankly, the essential difference in the two books seems to be mainly in the order of presentation of the material. The sequence of topics in the "Introductory College Chemistry" is arranged to avoid the presentation of all the theoretical principles in a continuous order, whereas the "General College Chemistry" presents the working portion of theoretical principles

previous to any discussion of the properties of the elements and their compounds. In other words, the only differences in the two books are the necessary changes in the introductory paragraphs of the various chapters resulting from the different arrangement of the material. One example will illustrate the point. The discussion of organic chemistry is introduced early in the list of topics in the "Introductory College Chemistry." On the other hand, all the material about organic chemistry is placed in the last chapter of "General College Chemistry."

Both books apply current views of atomic structure to the explanation of the properties of the elements. Quantitative experimental data are employed in the discussion in the fundamental principles and modern theories. The hydrogen ion,  $H^+$ , is used for simplicity instead of the hydronium ion,  $H_3O^+$ , in the discussion of oxidation-reduction reactions. However, the latter ion ( $H_3O^+$ ) is used exclusively in the discussions of ionic equilibrium following the chapter on acids and bases. The more recent concepts of acids and bases are presented in a very clear manner.

In each book the chapters on atomic structure, electronic distribution and valence furnish splendid examples of the evolution of material presented in elementary courses over a period of years. The books illustrate how possible it is to utilize our present knowledge of atomic structure in the discussion of the laws of chemical combination, valence and the structure of matter.

A wealth of material written in a very clear manner is included in each text. Carefully selected problems and questions are utilized to illustrate the principles discussed and correlate various concepts. Several tables of data which are useful to the teacher and to the student for the solution of problems and the illustration of principles are included in the appendices. The two books are not as extensively illustrated as some of the books now on the market, but the illustrations are well chosen and well drawn.

Teachers of elementary chemistry should find either of these books to be very satisfactory for class use, or, if not, as an excellent reference book to supplement another text.

L. L. QUILL

OHIO STATE UNIVERSITY

## REPORTS

### SOME EDUCATIONAL EFFECTS AND IMPLICATIONS OF THE DEFENSE PROGRAM<sup>1</sup>

I CAN say with propriety that our defense work is concerned with problems of urgent importance to our

<sup>1</sup>From the report of Dr. Karl T. Compton, president

country's military effectiveness and that gratifying progress is being made in attaining objectives. These statements are true not only of the activities under

of the Massachusetts Institute of Technology, to members of the corporation.

way at this institution, but of the over-all Federal scientific research program in which more than a hundred other educational institutions and many industrial organizations are collaborating in the greatest scientific mobilization in the history of our country.

While the diversion of energies to defense work has disrupted many normal activities and retarded important developments in both education and research, the defense program promises some important gains in terms of the peace-time objectives of educational institutions which are actively engaged in it. It is serving to bring educational staffs into closer contact with industry and operating agencies of the government. It is promoting cross-fertilization among many different fields and many fine minds from different backgrounds. Much of the research is actually an intensification of investigations already under way and is so fundamental that we would have welcomed at any time the opportunity to undertake it with the effectiveness that subventions from government and industry now make possible. While contributing directly to war-time needs, it is yielding new developments, new techniques and new understanding which will have important peace-time applications and which presage a new prosperity for science and engineering after the war.

The program has likewise provided a dramatic demonstration of the national usefulness of an educational institution which maintains a great staff and facilities for research and development in those forward-flowing streams of science which become the reservoirs of power when engineering art has harnessed them. This harnessing of science is accelerated in a time of national emergency. Nowhere else in our country, except in our great educational centers of research, is there a comparable reserve of scientific manpower, of new technological ideas, of laboratory facilities. A few such outstanding institutions become, in time of emergency, centers of concentration on objectives of first magnitude. Other institutions, less powerful in research facilities, play their important rôles as centers for other important work of less magnitude and as reservoirs of technical man-power. In normal times, each and all contribute to the education of our people, the operation of our industrial economy and the increase of scientific knowledge in this technological age.

From the lessons of the present situation I see emerging as a clear objective the outlines of an educational and research institution based upon the present ideals and objectives but incorporating a greatly magnified capacity for national service and commanding a wider recognition of the availability of its technological assets for use by government and industry.

Let me describe this institution of to-morrow as a

"super institute of technology" and suggest some of its features, as drawn from the lessons of past and present. It should possess an operating organization flexible enough to meet emergency conditions, alert enough to provide the *modus operandi* for meeting unusual needs in normal times and farsighted enough to provide the means of dealing with new needs or opportunities in advance of their urgent demands. The institution must be organized quickly and effectively to assist industry and government in the solution of both normal and emergency problems and in obtaining highly qualified men. Through the possession of advanced and specialized equipment and laboratories it must have investigatory resources anticipating future needs and not available elsewhere. Of major importance, it must have a staff of outstanding experts marked not alone by individual brilliancies but by a homogeneous strength that insures cooperative, creative work, capable of developing a body of advanced thought and applying it to new problems. And finally, it must have a student body of the highest possible caliber—graduate students of distinction and undergraduates of honors caliber and treated as honors students.

In idealized terms this is the type of institution toward which we should aspire. Our trend has been in this direction; our resources, traditions and prestige give us a good basis from which to proceed. The experiences of the present emergency serve to reinforce our faith in the social values and the practical feasibility of this educational ideal. What we need to have are considerably ampler financial resources and wisdom in using them.

Of our actual trend in this direction there have been many evidences, aside from the defense program, in the past few years. The increasingly careful selection of undergraduate students, the growth of our graduate school without prejudice to the undergraduate program, the mounting volume of pure scientific research and of research and development projects brought to us by government and industry, the increasing number of graduate fellowships supported by industry and the growing demand for technically trained men, especially those with graduate training, are indications of the trend. Certainly it is not idle speculation to observe that when the demands of the present emergency have been fulfilled, science and engineering will be faced with the task of creating new wealth to replace the colossal waste of war, and that this will require technological institutions of ampler resources and instrumentalities for public service than we have to-day, and that the Massachusetts Institute of Technology should serve in these directions with all the effectiveness and resource which we can muster.

## SPECIAL ARTICLES

THE COMPARATIVE VALUE OF THE BLOOD  
PLASMA VITAMIN A CONCENTRATION  
AND THE DARK ADAPTATION AS A  
CRITERION OF VITAMIN A  
DEFICIENCY

RECENTLY several investigators have shown<sup>1, 2, 3</sup> that poor dark adaptation may occur before vitamin A deficiency becomes so extreme as to cause clinically manifest symptoms of this deficiency, such as night-blindness and xerophthalmia. In the present study, we have compared the results of dark adaptation tests with plasma vitamin A values in infants and children and have also investigated the relation between the plasma vitamin A concentration and the vitamin A intake in infants.

We have previously shown<sup>4</sup> that the concentration of vitamin A in the blood plasma reflects the level of vitamin A intake in the rat when this intake is less than 50 International units daily. Thus, at intakes of 0, 1, 2, 10 and 25 units daily for 6 weeks, the average plasma concentrations of vitamin A at the end of this time were, respectively, 0, 7, 14, 35 and 69 units per 100 cc. The plasma vitamin A concentration reached an optimal value (about 100 units per 100 cc) at an intake of 50 units daily, and remained at this optimal level for intakes up to 1,000 units of vitamin A daily. There was no storage in the liver, the chief reservoir of vitamin A in the body, at plasma vitamin A concentrations less than 35 units per 100 cc, slight storage at concentrations between 35 and 50 units per 100 cc, and increasingly larger storage at blood plasma concentrations above 50 units per 100 cc.

Forty-six infants, 3 weeks to 6 months of age, receiving 1,200 to 1,500 units of vitamin A daily in their diet showed a mean plasma vitamin A concentration of 74 units per 100 cc. This value differed significantly from the mean value, 93 units per 100 cc, in a group of 47 infants of the same age and on the same diet, but receiving a supplement of 17,000 units of vitamin A daily. Dark adaptation tests revealed no difference between the mean final rod threshold values of two groups such as described above; the technique for determining dark adaptation in infants was previously described.<sup>5</sup> In these 93 normal infants, we en-

countered no plasma vitamin A concentration below 45 International units per 100 cc; this value would therefore seem to be the lower limit of normal, on the basis of our analyses.

Six infants, 3 weeks to 2½ months of age, were placed for periods of from 2 to 4 months on a diet which contained about 335 units of vitamin A daily, or one fourth the vitamin A content of the average diet for this age. The average concentration of vitamin A in the plasma before the institution of this diet was 74 units per 100 cc; at the termination of this diet the average plasma vitamin A concentration had fallen to 61 units per 100 cc. There was a decrease in the plasma concentration of vitamin A in every case, ranging from 4 to 23 units. Yet, in no instance did the dark adaptation become abnormal.

A second group of 12 infants, 1½ to 4 months of age, was placed on a diet devoid of vitamin A for periods of from 2 weeks to 4½ months. During this time the infants appeared normal, gaining well and being no more susceptible to infections than those receiving large quantities of vitamin A. Of 4 infants who received the vitamin A-free diet for a period of 2 to 6 weeks, one showed a plasma vitamin A concentration of 37 units per 100 cc, well below the lower limit, 45 units per 100 cc, of the normal range in infants of this age. Of the 8 infants who were on the diet for 2 to 4½ months, 6 showed low values ranging from 11 to 44 units per 100 cc. The 2 infants whose plasma concentration of vitamin A did not fall below 45 units had received 17,000 units of vitamin A daily for one month prior to the beginning of the vitamin A-free diet and presumably had accumulated large stores.

All 7 infants who had low plasma vitamin A concentrations—that is, concentrations below 45 units per 100 cc, also had abnormal dark adaptation. Five of these infants were then given 150 units of vitamin A daily for one month. As shown in table 1, the dark adaptation became normal in every instance, although the plasma concentrations of vitamin A remained low. In other words, at this stage the plasma vitamin A level revealed clearly the known history of a greatly restricted vitamin A intake, whereas the dark adaptation tests gave no suggestion of it.

Nineteen normal children, 6 to 12 years of age, showed an average plasma vitamin A concentration of 117 units per 100 cc (range: 70 to 197 units). Dark adaptation tests revealed normal final rod thresholds in every one of these 19 children. In contrast, 118 children of the same age group who had been admitted to the hospital because of malnutrition, upper

<sup>1</sup> S. Hecht and J. Mandelbaum, *Jour. Am. Med. Assn.*, 112: 1910, 1939.

<sup>2</sup> J. M. Lewis and C. Haig, *Jour. Pediatrics*, 16: 285, 1940.

<sup>3</sup> P. C. Jeans, E. L. Blanchard and F. E. Satterthwaite, *Jour. Pediatrics*, 18: 170, 1941.

<sup>4</sup> J. M. Lewis, O. Bodansky, K. G. Falk and G. McGuire, *Proc. Soc. Exptl. Biol. Med.*, 46: 248, 1941.

<sup>5</sup> J. M. Lewis and C. Haig, *Jour. Pediatrics*, 15: 812 (1939).

TABLE I

THE EFFECT OF THE ADMINISTRATION OF 150 UNITS OF VITAMIN A DAILY FOR A PERIOD OF FOUR WEEKS ON THE PLASMA VITAMIN A CONCENTRATION AND ON DARK ADAPTATION IN INFANTS PREVIOUSLY FED A VITAMIN A-FREE DIET FOR TWO TO FOUR MONTHS

Name	Age Months	Plasma vitamin A concentration		Final rod threshold	
		Prior to adminis- tration	After adminis- tration	Prior to adminis- tration	After adminis- tration
		Units per 100 cc		Log micromicro- lambers	
J. K. ...	3½	13	16	4.4	3.3
A. I. ...	3½	44	48	4.4	3.0
N. R. ...	5½	11	16	5.0	3.0
J. R. ...	6	23	35	4.7	3.3
L. R. ...	3¾	30	26	3.8	3.0

respiratory infections, rheumatic fever, dysentery, etc., showed an average plasma vitamin A concentration of 89 units per 100 cc (range: 25 to 198 units). It should be emphasized that these children were tested when they were afebrile, as it has been shown<sup>6</sup> that the concentration of vitamin A in the plasma falls precipitously during fever and returns to normal rapidly after defervescence. Twenty-two or 19 per cent. of these 118 children had plasma vitamin A concentrations below 67 units per 100 cc, the value we designated as the lower limit of normal in this age group. Only one of these 118 children exhibited abnormal dark adaptation.

The above results demonstrate that the plasma vitamin A concentration is a considerably more sensitive indicator of vitamin A deficiency than is the dark adaptation. We have recently observed an instance of malnutrition in an adult which illustrates this point strikingly. A woman in the seventh month of pregnancy had subsisted for several weeks on a diet consisting chiefly of coffee. She had developed marked anemia and polyneuritis; the latter cleared up promptly following thiamin chloride therapy and was evidently due to vitamin B<sub>1</sub> deficiency. The dark adaptation test showed a normal final rod threshold. In sharp contrast, the plasma vitamin A concentration was 40 units per 100 cc, a value considerably less than the lowest value obtained by Kimble<sup>7</sup> in a series of 34 normal women, namely, 64 units per 100 cc.

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<sup>6</sup> S. W. Clausen and A. B. McCoord, *Jour. Pediatrics*, 13: 635, 1938.

<sup>7</sup> M. S. Kimble, *Jour. Lab. Clinical Med.*, 24: 1055 (1939).

## PATHOGENESIS OF ERYTHROBLASTOSIS FETALIS: STATISTICAL EVIDENCE<sup>1</sup>

It was recently suggested<sup>2</sup> that erythroblastosis fetalis, a familial hemolytic disease of the newborn, results from the passage of the mother's immune agglutinins through the placenta to act on the susceptible blood of the fetus. The evidence indicates that the mother is immunized by a particular blood factor, Rh, transmitted from the father to the fetus but lacking in the mother. This isoimmunization of the mother was proposed as the explanation of the cause of hemolytic transfusion accidents associated with pregnancy.<sup>3,4,5</sup>

The agglutinable substance involved is the Rh factor recently discovered by Landsteiner and Wiener with the aid of rabbit sera obtained by immunization with rhesus blood.<sup>6</sup> Such agglutinins were shown to give reactions which ran parallel to the atypical agglutinins in the mothers' sera, induced, presumably, by isoimmunization with fetal blood.

To obtain further data on the relationship of the Rh factor and anti-Rh agglutinin to this disease, a statistical study was undertaken which forms the basis of this paper. The isoimmunization theory requires that the mothers of infants with erythroblastosis fetalis be Rh negative, while the affected child and the father must be Rh positive. Consequently, a selected population of such mothers should show a higher incidence of Rh negative than the random population. Furthermore, the fathers and the affected children should invariably be Rh positive. The results in Table I which conform to the theoretical expecta-

TABLE I

	Rh positive	Rh negative
Random population		
Male 829 .....	86.2 per cent.	13.8 per cent.
Female 206 .....	85.4 " "	14.6 " "
111 mothers of infants with erythroblastosis fetalis ..	9.0 " "	91.0 " "
60 husbands of Rh-negative mothers .....	100.0 " "	
58 affected infants .....	100.0 " "	

<sup>1</sup> From the Division of Laboratories, Newark Beth Israel Hospital, Newark, N. J., and the Laboratories of Mt. Sinai Hospital, New York, and the Woman's Hospital, New York. Aided by a grant from the Blood Transfusion Betterment Association of New York City.

<sup>2</sup> P. Levine, E. M. Katzin and L. Burnham, *Jour. Am. Med. Assn.*, 116: 825, 1941.

<sup>3</sup> P. Levine and E. E. Stetson, *Jour. Am. Med. Assn.*, 118: 126, 1939.

<sup>4</sup> A. S. Wiener and H. B. Peters, *Annals Int. Med.*, 13: 2806, 1940.

<sup>5</sup> P. Levine and E. M. Katzin, *Proc. Soc. Exp. Biol. and Med.*, 45: 843, 1940.

<sup>6</sup> K. Landsteiner and A. S. Wiener, *Proc. Soc. Exp. Biol. and Med.*, 43: 223, 1940.

tion provide striking evidence to support the importance of the Rh factor in the etiology of erythroblastosis fetalis.

In a general way it may be assumed from these findings that isoimmunization of the Rh negative mother by the Rh factor of the fetus may explain the incidence of erythroblastosis fetalis in 91 per cent. of the families studied. That other blood factors are capable of inducing isoimmunization is shown in one of the 10 Rh positive mothers whose blood contained an atypical agglutinin of an entirely different specificity.<sup>7</sup> Still another blood factor identified by an agglutinin recently described by Levine and Polayes<sup>8</sup> is capable of inducing isoimmunization. This woman, who suffered a transfusion accident during her puerperium of her twelfth pregnancy, had 4 miscarriages but no infants with erythroblastosis fetalis.

The studies on the specificity of various anti-Rh sera produced by isoimmunization in these mothers showed that these sera differ somewhat in their specificity. While the great majority of bloods give identical reactions when tested with various anti-Rh sera, several bloods inactive with a particular serum were found to react with other sera. A similar finding was observed by Landsteiner and Wiener.<sup>9</sup>

Consequently, the bloods of the remaining 9 Rh positive mothers not containing atypical agglutinins will have to be retested with the new agglutinins as well as with a variety of anti-Rh sera.

The correlation of anti-Rh agglutinins and the postpartum interval when the first tests were done, is shown in Table 2.

TABLE II  
Incidence of anti-Rh agglutinins in 101 Rh-negative mothers

Interval after last delivery of an affected infant	Agglutinins present	Agglutinins not found
2 months .....	24	23
2 months to 1 year .....	3	7
1 year or longer .....	2	36
No data .....	0	6
Total .....	29	72

Atypical agglutinins in the Rh negative mothers were found in 50 per cent. of the cases in tests made within the first two months after delivery of an infant with erythroblastosis fetalis. It may be assumed that the incidence of anti-Rh agglutinins will be higher if such mothers are tested at intervals in the course of subsequent pregnancies which may result in other affected infants.

<sup>7</sup> This case, a patient of Dr. C. Javert, will be published separately.

<sup>8</sup> P. Levine and S. H. Polayes, *Annals Int. Med.*, 14: 1903, 1941.

<sup>9</sup> K. Landsteiner and A. S. Wiener, personal communication.

It is of interest that in 2 cases atypical agglutinins could still be demonstrated 2 and 2½ years, respectively, after the last delivery of an infant with erythroblastosis fetalis.

According to the concept of isoimmunization, the mother's immune agglutinins pass through the placenta and exert lytic action on the susceptible fetal blood. However, this could not occur if the Rh factor had a wide distribution in tissue cells and body fluids, which would specifically bind the anti-Rh agglutinins. Tests made with numerous specimens of saliva and a small number of specimens of seminal fluid and sperm cells of Rh positive individuals indicated that the Rh factor was not present in this material. Thus there is justification, at least for the present, to assume that the Rh factor may be limited to red blood cells.<sup>10</sup> However, a comprehensive study of various organs and body fluids is desirable.

In a future publication evidence will be presented that the familial nature of erythroblastosis fetalis depends upon the heredity of the blood factors involved. The striking incidence in certain mothers and the sporadic occurrence in others depends upon the homozygosity or heterozygosity of the father's blood. That the Rh factor is inherited as a mendelian dominant property was recently demonstrated by Landsteiner and Wiener.<sup>9</sup>

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#### MOSAIC, CHLOROSIS AND NECROSIS IN VIRUS-INFECTED PERENNIAL PEPPER CAUSED DIRECTLY BY PRODUCTS OF A DERANGED METABOLISM<sup>1</sup>

IN *Capsicum frutescens* L., a tropical perennial pepper, the level of concentration for Nicotiana Virus 1 is relatively low under all conditions of growth studied. When the leaves are wiped with virus local necrotic lesions develop and the leaves absciss.<sup>2</sup> When the inoculated plants are cultured near 32° C. small quantities of virus pass from the inoculated leaf, and systemic infection occurs,<sup>3</sup> but does not when cultured near 23° C. At the high temperatures the branches, stems, taproots and roots become necrotic. These tissues develop a dark brown to black color and death results. Old woody plants are more resistant than young succulent plants.

<sup>10</sup> Cf. A. S. Wiener and S. Forer, *Proc. Soc. Exp. Biol. and Med.*, 47: 215, 1941.

<sup>1</sup> Studies conducted under Bankhead-Jones Project S.R.F. 2-17, U. S. Department of Agriculture, Bureau of Plant Industry and Agricultural Chemistry and Engineering cooperating.

<sup>2</sup> F. O. Holmes, *Phytopathology*, 26: 896, 1936.

<sup>3</sup> H. H. McKinney, *Jour. of Heredity*, 28: 51, 1937.

Before abscission, a secondary chlorosis usually involves the leaf tissues not included in the local infection sites, especially at the higher temperatures with summer sunlight. When one small marginal zone on the leaf or the petiole is inoculated, the secondary chlorosis involves the entire leaf.

Over a period of five years, 125 lots of leaf tissue well outside of the inoculated zones were isolated before and during the progress of secondary chlorosis, and in no case was a sign of virus obtained in *Nicotiana tabacum* L., *N. glutinosa* L., *N. langsdorffii* Schrank, *N. sylvestris* Spegaz. and Comes, or in *Phaseolus vulgaris* L., variety Scotia. Extracts from these pepper tissues were dialyzed to remove any possible inhibiting agent, but no signs of virus were obtained after dialysis.

The inoculated zones, with few exceptions, contained virus. However, 11 lesions per leaf on beans was the highest count obtained; usually the counts were less.

Typical, fully developed light- and dark-green mosaic mottling frequently appeared on new leaves remote from the zones of inoculation when woody pepper plants were cultured near 32° C. This mottling sometimes persisted for several days before the leaves became necrotic. Separate assays made on 10 mosaic leaves revealed no signs of virus before the appearance of necrosis, but when the first faint signs of necrosis appeared in the mottled leaves, virus could be detected in the tissues by means of inoculations into tobacco. Attempts to demonstrate that this mosaic is caused by a virus specific to pepper plants failed.

In the branches, stem, taproot and roots, the virus was most concentrated in or very near to the necrotic cortex or cambium. No virus was detectable in the necrotic xylem of the stem.

When the lateral roots or the tap roots were inoculated and the plants were cultured near 32° C. necrosis resulted but did not advance more than one-half inch up the stem, and no signs of virus were revealed above this point. However, when the lower stem or the upper part of the tap root was girdled and the xylem was solidly necrotic, these plants wilted. Tests indicated that the water-conducting tissue was obstructed as a result of the necrosis. Necrosis occurred considerably in advance of the virus in the xylem, but not in the cortex.

It is concluded that the secondary chlorosis, the mosaic mottling and the xylem-necrosis are induced directly by translocated or diffused products of a deranged metabolism, which in turn is induced by relatively small amounts of virus in remote zones.

Typical fully developed mosaic mottling in tobacco has not been observed to occur in advance of the virus. However, this does not preclude the possibility that mosaic in tobacco is induced directly by the products of a deranged metabolism.

One of the authors (Hills) found that pepper-leaf tissue in the advanced stages of secondary chlorosis contained an increased amount of peroxidase, and reduced amounts of oxidase and catalase, in comparison with alternate normal leaves from the same branches. These alterations in enzyme balance, and the ultimate chlorosis, show that the virus is capable of inciting profound changes in tissues remote from zones of detectable virus, and finally, these changes are so drastic in the necrosed pepper tissues that the virus is completely destroyed soon after these tissues have desiccated.

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## SCIENTIFIC APPARATUS AND LABORATORY METHODS

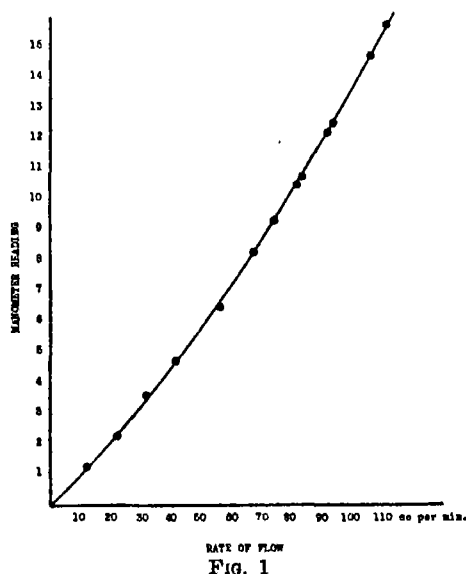
### A METHOD FOR CONTINUOUSLY DETERMINING THE RATE OF OXYGEN CONSUMPTION FOR LABORATORY ANIMALS

METHODS now available for determining the rate of oxygen uptake of animals consist essentially of methods of measuring the volume of oxygen taken up over known periods of time. The value for the rate of oxygen uptake calculated from such data gives an average value of the rate over the interval of time employed and tends to obscure any rapid changes that may have occurred. The present apparatus was designed for use in experiments where changes in metabolism occur rapidly and where a prolonged continuous record is desired giving instantaneous values for the rate of oxygen uptake.

The apparatus consists of an air-tight chamber just large enough to hold the animal, lined with wire gauze soda lime containers. These should be arranged so as to assure a rapid and constant rate of absorption of expired CO<sub>2</sub>. This chamber is connected with an orifice type flowmeter which consists of a capillary connecting the oxygen supply with the chamber, across which is connected a U-tube water manometer. The rate of flow of oxygen through the capillary is proportional to the pressure across it, so that it is an easy matter to calibrate the reading of one arm of the manometer to read directly in cc/min. This calibration is accomplished by setting the pressure to different values by means of the reducing valve on an oxygen tank and determining the corresponding flow by timing the displacement of water from a volumetric

flask. A typical calibration curve so obtained is shown in Fig. 1.

The reading of one arm of this manometer is made automatic and continuous by placing it before a slit in a light-proof box containing a kymograph loaded with photographic paper (Eastman Kodak type Azo 4). The light from a point source, such as an automobile headlight bulb 2 meters away, is focused on the paper by that portion of the tube containing water, is blocked out by the meniscus, and is diffused by the empty portion. With the proper adjustment of the



light intensity this results in a record in which a light-gray area is separated from a black one by a white line.

By placing fine wires across the slit at points determined from the calibration curve, lines are traced on the record so that it may be read directly without referring to the curve. A signal magnet may be placed in front of the slit below the base line to indicate time and a tambour may be similarly arranged to record activity, although this has been found unnecessary since the record itself is a sensitive recorder of changes of activity. The arrangement of the apparatus is shown diagrammatically in Fig. 2. The size of the capillary is determined by the range of flow to be covered, and must be drawn out of thick-walled capillary tubing since there are no standard orifices fine enough available.

The animal is placed in the chamber and after testing for leaks is placed in the water bath and connected to the flowmeter. The input side of the flowmeter is connected to a large rubber bag containing oxygen under slightly greater than atmospheric pressure. The stopcock is opened to bypass the capillary while

the apparatus comes to equilibrium and is then closed. As the oxygen is taken up by the animal and  $\text{CO}_2$  is absorbed, the pressure in the chamber falls. This causes a difference of pressure across the capillary resulting in a flow of oxygen into the chamber. When

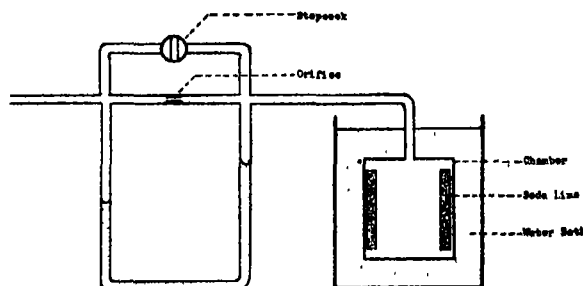


FIG. 2

this flow balances the uptake of the animal, the pressure remains stationary and the rate of flow as registered by the flowmeter gives the true rate of oxygen uptake of the animal. For this reason, the flowmeter record is only reliable where the rate is constant, since it will lag behind a rapidly increasing rate and give high readings while the rate is falling. However, this lag is very slight so that changes occurring over a period of a few minutes are fairly accurate and the direction and magnitude of changes can be told within a few seconds. The temperature of the jar must be controlled within a few degrees, although even large changes in temperature render the record inaccurate only during the period of change.

This apparatus has been used for mice, rats, guinea pigs, dogs and *Macacus rhesus* monkeys, giving basal values which check well with the available literature. It has given a clearer picture of the rapid changes due to activity and short-acting drugs than would have been possible with any other method.

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## BOOKS RECEIVED

- CAMPBELL, LEON and LUIGI JACCHIA. *The Story of Variable Stars*. (Harvard Books on Astronomy.) Pp. v + 226. 82 figures. Blakiston. \$2.50.
- LANGTON, CLAIR V. *Orientation in School Health*. Pp. xvii + 680. Illustrated. Harper. \$3.00.
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- WHIFFLE, FRED L. *Earth, Moon and Planets*. (Harvard Books on Astronomy.) Pp. vi + 293. 140 figures. Blakiston. \$2.50.

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## THE COSMICAL ABUNDANCE OF THE ELEMENTS<sup>1</sup>

By Dr. HENRY NORRIS RUSSELL

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EIGHTY-EIGHT chemical elements are known—(not counting two whose isolation is still a matter of controversy, nor unstable isotopes of short life, produced artificially). For all these, methods of isolation and of qualitative and quantitative analysis have been developed in chemical and physical laboratories, so that it is only a matter of hard work for the analyst, presented with a sample of matter of any sort, to determine its composition with accuracy. The simplest definition of composition alone concerns us here—the relative abundance of the elements in our specimens. We may measure this by weight or by the numbers of atoms of different kinds. The chemist is

likely to do the first, the astrophysicist the second. As one of the latter, it is not my place to-day to do more than mention the many methods by which the chemist separates the various elements, and avoids loss of them in the process. Suffice it to say that the separation is sometimes easy, sometimes very difficult (as for the rare earths). The best available tests are much more sensitive for some elements than for others, and it is peculiarly hard to detect the latter when they are present in but small proportion, say less than one ten-thousandth of the whole mass.

The physicist can at times come in to ease the situation. Radio-active tests are available for but a small number of the elements, but can detect these in excessively small amounts.

<sup>1</sup> An address delivered at the symposium, September 26, 1941, in connection with the Fiftieth Anniversary Celebration of the University of Chicago.

Spectroscopic observations, in the romantic age of science, seventy years or so ago, led to the discovery of several of the rarer elements. For many years, this method, except for simple applications in qualitative analysis, was left to the astronomers. In recent times, however, it has been developed into a very rapid and fairly accurate analytical procedure, of considerable practical value. It has the great advantage that all the constituents which are present in the sample may be investigated at once, by a single process: but though the tests for some elements are of great delicacy, those for others are of such low sensitivity as to be substantially useless. Fortunately, the spectroscopic tests are often delicate when the chemical procedure is troublesome, and the two supplement each other.

To find, even roughly, the *cosmic* abundance of the elements is another thing. We can get a good determination of the *terrestrial* abundance provided that we define this adjective to mean the abundance within the thin superficial region on our planet extending a few miles above its surface and a mile or two below. The geologists can help us out by structural studies that extend the region in which the nature of the rocks may reasonably be inferred a few miles deeper.

But, even so, our knowledge is confined to a surface shell of our planet far thinner in proportion to its diameter than the skin of an orange or even an egg-shell.

Making the best of what we have, and combining analyses of rocks of various kinds, of sea-water and of the air, in proportion to the total mass of each, we can get a very good idea of the composition of the earth's crust—that is, of everything that lies above some arbitrary depth such as ten miles below sea-level. We have here a solid mass of silicates of a few well-known metals, with a wash of water on its surface. Oxygen, whether by weight or by number of atoms, is the most abundant element. Silicon is next; and then come six metals, aluminium, iron, magnesium, calcium, sodium and potassium. These eight elements account for nearly 98 per cent. of the whole by weight. The hydrogen in the sea-water makes up but a part of the remaining 2 per cent.

But this surface layer is not likely to be a fair sample of the composition of our planet: and, indeed, we know that it is not. Measures of gravity on the earth's surface, and of its variation from equator to pole, show that the mean density is nearly twice that of the superficial rocks, and the central density much higher; and seismological studies reveal the existence of a central core nearly 4,000 miles in diameter, which appears to be liquid, and of at least one considerable discontinuity in density in the shell which overlies this.

We would be completely at loose ends, were it not

that nature generously provides us with other samples, in the form of the meteorites which fall to the earth's surface from interplanetary space.

The larger ones, which get through the atmosphere and can be studied, show a considerable variety of composition. Some are masses of silicate rock; some are composed mainly of iron, alloyed with nickel; and some contain large quantities of metallic sulfides. V. M. Goldschmidt, the greatest authority on geochemistry, estimates that on the average there are ten parts by weight of stone, two of iron and one of sulfides. Taking an average on this basis, we may hope to have something more fairly representative of the cosmos than is the skin of our planet.

We must still be cautious. Accurate photographic observations of the trails of bright meteors, of which a good many have been secured in the last few years, show that almost all of them, before they hit the earth, were pursuing elliptical orbits of rather short periods, and were, in effect, tiny asteroids. They are samples of the solar system, perhaps, but not of the universe at large. The belief that most meteors have invaded our system from interstellar space has been greatly weakened by these new and much better observations—though it may well be true for the tiny shooting stars which are consumed in the upper air and never reach the ground.

Moreover, the fiery ordeal which even a large meteorite undergoes by friction in the atmosphere may have a strongly selective effect in determining what gets through.

In the heads and tails of comets, the spectroscope reveals an abundance of gaseous compounds of carbon and nitrogen. It seems clear that these gases escape from solid particles in the comet's nucleus, when they are warmed by the sun. But ordinary meteorites are not rich in such compounds. It may quite possibly be that among the solid cometary particles, some are composed largely, if not entirely, of carbon compounds. Such a body, in its flight through our oxygenated atmosphere, would be utterly consumed. It would, in Billy Sunday's famous phrase, "have no more chance than a celluloid dog chasing an asbestos cat through Hell." So we can not be any too sure that we have a fair sample in the meteorites which are picked up. But, anyhow, we have the best there is.

The average composition of meteorites differs from that of the earth's crust significantly, but not very greatly. Iron and magnesium are more abundant, and nickel and sulfur rise from subordinate positions to places in the list of the first ten. Silicon, aluminium and the alkali metals, especially potassium, lose what the others gain.

The composition of the earth as a whole is prob-

ably much more similar to the meteorites than that of its "crust," which is substantially that of the granitic rocks which form the basement of all the continents, but extend to a depth averaging less than twenty miles. Granites are rich in aluminium and the alkalis, while the deeper and denser rocks are ferromagnesian. The known properties of the central core are entirely consistent with the assumption that it is composed of molten iron—though not enough to prove it. The generally accepted belief that it is composed of nickel-iron is based on the ubiquitous appearance of this alloy in metallic meteorites.

It is the earth's crust, then, and not the meteorites, which we may regard as peculiar in composition. Its distinctive characteristics follow from the reasonable hypothesis that it is a segregate from an originally molten magma which, being lighter, floated upon the main basaltic mass, while the dense molten metals sank to the center, and water-vapor and the permanent gases escaped to the surface.

In such a separation, certain elements tend to be concentrated in each phase. V. M. Goldschmidt, the principal authority on this subject, distinguishes the *siderophile* group of elements which dissolve preferentially in the molten iron, the *lithophile* group which go mainly into the silicate layer and the *atmophile* group which escape, as free gases or volatile compounds, and form the ocean and the atmosphere. Chemical considerations suggest the existence of a fourth *chalcophile* group, which would concentrate in the layer of metallic sulfides which would form if enough sulfur were present. Such a sulfide layer, in the earth, would lie just outside the metallic core (and be considerably denser than the superimposed silicates), but there is little seismological evidence in favor of its existence.

There are many interesting details. Rare elements with atoms or, more precisely, ions of about the average size tend to slip in here and there into the crystal-lattices of the minerals which compose the bulk of the rocks, and get lost—so that ordinary analysts have a hard job to find them. Those with unusually small ions, such as lithium, or large ones, such as the rare earths, remain in the residual fluid magma, and are concentrated in the granitic layer, and especially in the pegmatites, which solidify last.

We can escape from our planet and attempt a truly cosmic analysis, with the aid of the spectroscope alone—happily a very powerful aid.

The qualitative analysis of the sun and stars, which recognized in them the familiar elements, still presents the most impressive of all evidence of the uniformity of nature.

No technical prose can express its philosophic aspect as well as Stedman's stanza:

White orbs like angels pass  
Before the triple glass

That men may scan the record of each flame,  
Of spectral line and line  
The legendry divine

Finding their mould the same, and aye the same,  
The atoms that we knew before

Of which ourselves are made,—dust, and no more.

Returning from poetry to prose, we note that, at first glance, the stars, though revealing only known elements, appear to be very different in composition. Some show a host of lines of the metals, others relatively few, belonging to the permanent gases. Twenty years or so ago the riddle was solved, when Saha, applying the newly developed theory of ionization, showed that these differences were primarily to be attributed to temperature. This is too long and too well known a story to tell now. It may suffice to say that, in the cooler stars, the non-metals are not stirred up sufficiently to absorb lines in the rather narrow spectral regions which can be observed through our atmosphere, while in the hotter ones the metals, by repeated ionization, are put into a state where they absorb only in the inaccessible ultra-violet. Miss Payne's pioneer conclusion of 1925, that the general run of stars are very similar in composition, has been fully confirmed by subsequent investigations.

Aided by the advance of atomic theory, astrophysics has identified almost every important spectral line which has been observed in extra-terrestrial sources. We find, in every once-perplexing case, familiar elements, shining under unusual conditions. In the nebulae, for example, the atoms are undisturbed by collisions long enough to allow them to emit lines which would normally be "forbidden." The last great riddle—the spectrum of the solar corona, has been interpreted by Edlén in terms of forbidden lines of very highly ionized but familiar atoms of iron, calcium and nickel.

For a detailed analysis for many elements, we must have spectra of high dispersion, showing the fainter lines, and resolving close groups. In the sun, which gives us plenty of light, sixty elements have been identified. For almost all the rest, the strong lines are in inaccessible parts of the spectrum, and the observable lines should at best be very faint so that failure to find them is not surprising.

Spectra of the brighter stars, taken with great telescopes and spectrographs, show a wealth of detail. The most complete study so far, on Beta Pegasi, has identified more than forty elements.

Quantitative analysis is always more difficult than qualitative. It stands to reason that, the more atoms are at work producing a spectral line, the stronger the line will be. But the relation is complicated. Even

with an absorbing layer of gas in the laboratory, of uniform pressure and temperature, the increase of strength of a line with the number of atoms is rapid for faint lines, slows up very much for those of moderate intensity, and increases again for strong lines, though to a less degree than at first.

In a stellar atmosphere, which has no sharp boundaries, but thins out gradually into space above, and becomes increasingly hazy below, the situation is more complicated, but the curve of growth which finally emerges from the analysis is of very similar form.

The exact shape of such a curve is influenced by the temperature of the atmosphere, turbulent motions within it, and by the influence of collisions between atoms in broadening the stronger lines. For any given star, it must be found by observation. With good spectra, it is fairly easy to measure the equivalent widths of the lines, which indicate how much light each one cuts out of the spectrum. The "number of atoms acting" to produce a line is a somewhat Pickwickian phrase. A given line of iron, for example, is absorbed only by those atoms which happen to be in a certain one of the hundreds of energy-states in which the atom can exist.

The fraction of all the neutral iron atoms which are in such a state depends upon the "weight" of the state and on the temperature. But atoms in this state can absorb many different lines. What proportion of them "works" on any one of these lines is fixed by the laws of spectral structure: but it can at present be calculated theoretically only for the simplest spectra, such as that of hydrogen. In complex spectra, however, there are numerous line-groups, known as multiplets, in which the relative numbers of atoms acting to produce the lines—the transition-probabilities—are given by fairly simple formulae. With the aid of these, and of extended groups called supermultiplets, it is possible to find the relative number of atoms which act to produce lines of known equivalent widths, and so by a process of successive approximation to draw the curve of growth and find the "excitation temperature" of the atmosphere as well. The multiplet formulae are approximations based on a simplified theory which overlooks numerous complications. It is probable, however, that the resulting errors average pretty well out when numerous multiplets are used.

The actual line-strengths may be found by laboratory measures. These are difficult, and great care must be taken to avoid systematic errors. Progress along this line is at present rapid, and we may hope to have, in a few years, measured intensities which remove the uncertainties just mentioned. The theory will doubtless advance too, but it is going to be very complicated.

The absolute number of atoms, per square centimeter of the sun's surface, is harder to determine. But this tells us about the *opacity* of the atmosphere—how far down we can see into the increasing incandescent fog—and not about its composition.

It is, however, important to know whether the atmosphere is equally opaque for light of different wave-lengths. Otherwise, we have to allow for the fact that we "see down" deeper, and through a greater quantity of gas, in some parts of the spectrum than in others. There is fortunately an independent test for this in the degree of darkening of the solar disk toward its edge. This shows that the differences in general opacity are small and no serious error is committed by ignoring them.

If the same curve of growth can be used for lines of all elements—which again is probably a tolerable approximation—we can find the numbers of atoms of various elements which are engaged in the production of lines in the observable part of the solar spectrum (from about 3,000 to 12,000 Ångströms).

If we know the transition probabilities we can pass from the number of atoms "doing" a particular line to the whole number in the atomic state from which it is absorbed, and then the number of atoms in other states, and so to the whole number of atoms of the element.

Here we meet another complication. Neutral atoms, and those which have lost one, two or more electrons have entirely different spectra, which must be treated separately. In the sun only atoms which have lost one electron, or which retain them all, are important. In the stars, we have many which have lost two or three.

The percentage of atoms in these successive conditions depends of course on the energy necessary to pull the electrons off—the ionization potentials—and also on the temperature and the pressure of the gas. For several elements—calcium, titanium, etc.—the methods previously described give good determinations of the numbers of both neutral and singly ionized atoms. From these the pressure can be found (a suitable average representing the atmosphere as a whole). Thus, if we know for other elements the numbers of atoms in either the neutral or the ionized state we can calculate those in the other, and arrive at last at a complete census of the atoms of a given element.

The first attempt to analyze the sun's atmosphere in this way was made by the speaker twelve years ago. It was emphatically a reconnaissance in new territory. The theory of the curve of growth did not then exist; the equivalent widths had been measured for only a very few of the strongest lines, and only Rowland's estimates of intensity, on an arbitrary

scale, were available for the rest; and there was no way of determining whether lines of the same intensity in different parts of the spectrum were produced by the same number of atoms.

It is remarkable that, with these handicaps, the results were as good as they were. When the old calibration is converted into a curve of growth, the agreement with the curve recently adopted by Menzel and now widely used is very close.

A similar analysis, using all modern refinements, is being made by Dr. Goldberg. Through his courtesy, I am able to present a preliminary comparison of the older results with his. After allowance for the difference in zero-points, and in the assumed temperature of the solar atmosphere, the average deviation between the two determinations of the logarithm of the number of atoms above the photosphere is  $\pm 0.28$  for 19 elements for which the data are good or fairly good. This corresponds to a factor of 1.9—small compared with the range in abundance among these elements, which is about 200,000-fold. The agreement for the weaker determinations is as good as could be expected, except for beryllium, where the results depend on two faint lines near the ultra-violet limit of the solar spectrum, where neither investigation had any observational test of an extrapolated calibration.

The actual numbers of atoms "above the photosphere" are smaller in Goldberg's list than in mine, by an average factor of about 30. This comes from his application of a correction for collisional broadening of the strong lines, which is undoubtedly sound, but was not so much as imagined twelve years ago.

Goldberg's calculations have not at present been extended to the rarer elements, whose presence is revealed in the sun only by weak lines, for which the equivalent widths have not yet been measured. For a comparison with Goldschmidt's data for meteorites, it is therefore still necessary to use the older analysis of the sun's atmosphere, which included 56 elements.

For the more abundant elements, which are not more than 100,000 times rarer than silicon or iron, the average discordance is  $\pm 0.45$  in the logarithm (a factor of 2.8) which, considering all the uncertainties of determination, does not indicate any definite difference of composition. For the rarer elements, Goldschmidt's values are greater than mine by a factor which ranges up to 20 or 30 for the rarest. These elements have to be determined from very faint Fraunhofer lines. For such lines the calibration at Harvard by Menzel, Goldberg and Cook (1940) gives a much larger number of effective atoms than the old one of 1929, and it is probable that the latter is at fault.

There is therefore no present reason to conclude

that meteorites differ in composition from the sun's atmosphere, so far as the metals are concerned.

For the non-metallic elements, especially the lightest ones, the situation is radically different. It is not easy to determine their abundance in the sun. Carbon, oxygen and sulfur have fairly strong lines in the deep red, and nitrogen faint ones, from which the number of atoms in the excited states which absorb these lines can be fairly well determined. But these states are highly excited. The number of atoms of each element in the normal state is enormously greater, by a factor whose value changes rapidly with the temperature. We do not yet know the temperature of the region in the sun's atmosphere where these lines are absorbed accurately enough to enable us to calculate good values of these huge correction factors. But despite this uncertainty, it is evident that these elements, except perhaps sulfur, are at least as abundant as the most abundant metals, and may be much more so.

Hydrogen stands by itself. Its lines are peculiarly subject to broadening by many influences, so that they can not be used to determine its solar abundance, except to show that it must be very great.

There are, however, several indirect ways of estimating the abundance of hydrogen relative to other elements, in the sun and the stars. No less than six of these have been worked through by various investigators, and all agree that measured by the number of atoms, hydrogen is at least a thousand times more abundant than all the metals together. The separate determinations of this ratio run from 1,000 to 8,000. The large values appear to be the best, so that we may, for the present, adopt 5,000 as a round number.

The abundance of the inert gases—helium, neon, argon, etc.—can not be determined at all in the sun, for they show no absorption lines, and only helium appears in emission in the chromosphere.

This serious gap in our knowledge has been filled by an investigation by Unsöld based on measures of line-widths in spectra of the star Tau Scorpii, taken at the McDonald Observatory. This star is so hot that the atoms of helium and neon are got into condition to absorb spectral lines. By a very ingenious method Unsöld has avoided the difficulties presented by the high temperature, and determined what appear to be reliable values for the abundances of the light elements, and also of magnesium, aluminium and silicon. He finds that, for every atom of magnesium or silicon (which are almost equally abundant) there are approximately 3 of carbon, 6 of nitrogen, 16 of oxygen, 18 of neon, 3,000 of helium and 16,000 of hydrogen. The enormous preponderance of hydrogen is again confirmed, and helium turns out to be a rather good second.

It is to be hoped that these results, which are much the best so far obtained, will soon be confirmed by similar studies of other stars, and that it may be possible to find in the same way the abundance of fluorine, sulfur, phosphorus and argon.

A large field for such studies is already available in the high-dispersion spectra of bright stars which exist at Mount Wilson, McDonald and some other observatories. Pending such precise studies, only large differences of composition among the stars can be detected by more obvious methods. In a number of important cases, these certainly exist. The most notable example is furnished by the stars of classes R and N, whose spectra show enormously strong bands due to carbon molecules and carbon compounds. Here there is no doubt that, as the late R. H. Curtiss first suggested, we have to deal with reducing atmospheres in the ordinary chemical sense, containing more carbon than oxygen, while the great majority of the cooler stars have oxidizing atmospheres, the excess of oxygen permitting the formation of the metallic oxides, which show in their spectra. Why a few of these stars show strong bands of zirconium oxide and most of them those of titanium oxide is not known.

At higher temperatures, where compounds are dissociated, differences in composition are spectroscopically less conspicuous. One star of about the sun's temperature, R Coronae Borealis, has been found by Berman to contain carbon in great excess and little hydrogen; and another, Upsilon Sagittarii, analyzed by Greenstein, shows helium in great preponderance and hydrogen almost absent.

There are many minor peculiarities—stars with strong lines of silicon or strontium or barium—which when fully analyzed may yield results of great interest. There is enough here to do to keep the greatest telescopes, and more astronomers than are likely to work at it, busy for years to come.

Outside the stars the opportunities of spectroscopic investigation are few, but of great interest.

In the gaseous nebulae, and in the envelopes which surround novae, atoms thinly strewn in space, near very hot stars, are set shining either by the direct effects of their radiation, or by radiation emitted by other atoms in the nebula, or by collision with electrons ejected from such atoms. These special conditions favor very strongly the emission of forbidden lines, and elements which have such lines in the observable region have much the best chance of detection. The light elements—nitrogen, oxygen, fluorine and neon—have this advantage, and are frequently found, as are sulfur, chlorine and argon. Hydrogen and helium, though possessing no forbidden lines, are very much in evidence, and must be here, as every-

where, overwhelmingly preponderant. The metals are here at a spectroscopic disadvantage, but faint lines of several of them have been found, and it appears that, allowing for the very different conditions of excitation, there is left remarkably little evidence of difference in composition.

Still more thinly strewn are the isolated atoms and molecules which are to be found in interstellar space. These reveal their presence only by absorbing the light from distant stars.

Once again they represent a peculiar state of matter, in which the atoms, as a result of long periods of complete isolation, unload any excess of energy which they may have contained, and all settle down in the ground state. In this condition the lines are greatly reduced in number. Of the thousands of iron lines, a dozen or so are left—of which only the strongest has been observed, while the great and complex cyanogen band reduces to a single line. Many abundant elements, for example, magnesium and silicon, are thus removed from our observation, since their remaining lines lie in the far ultraviolet, and are cut off by the ozone in our atmosphere. The few which have been detected are common elements—sodium, potassium, calcium, titanium and iron—with the compounds CH and CN. Hydrogen is not directly observable, but the presence of lines of both neutral and ionized calcium makes it possible to estimate the number of free electrons in space. This is far greater than the whole number of metallic atoms, and can be explained only by the presence of hydrogen, as usual, in great superabundance.

The relative rarity of hydrogen on earth, and its practically complete absence from meteorites, is simply explained as a gravitational effect. Meteorites—and, for that matter, asteroids—have much too small a gravitational attraction to keep the fast-moving molecules of hydrogen from flying off into space. The earth, in its present cool condition, can retain an atmosphere, but, if it had ever been really hot on the surface, it must have lost all its hydrogen and most of the other atmospheric gases. Meteorites and the earth have both just the composition which might be expected in solid bodies segregated by condensation from an incandescent mass of composition similar to the stars. Only those constituents which could condense into, or be absorbed by a molten magma would remain; the atmophile elements would escape. The meteorites have lost these wholly; the oceans and most of the air may well have come out of the solidifying interior of the earth after the surface had cooled considerably.

Jupiter and the other great planets have sufficient gravitational attraction to retain atmospheres, even

if they were very hot. Their atmospheres actually contain great amounts of hydrogen compounds, and their mean densities are low.

Only a very small portion of the known matter in the universe is in the atmospheres of the stars. An overwhelmingly large portion is deep in the interior of the stars, inaccessible to observation. Even here, however, atomic theory can follow it and find the elements divided into two groups—hydrogen and helium on the one side, and all the heavier ones on the other. The amount of heat radiated by a star depends mainly upon its mass, rather little upon its size or internal distribution of density, but a good deal upon the relative proportion in its interior of these two groups of elements. Many investigators, from Eddington to Strömberg, agree in finding that the observed data

for stars as different as the Sun, Sirius and Capella, indicate that, if there is no helium, the interior contains 35 per cent. (by weight) of hydrogen, with the rest heavier elements. Counting by number, the hydrogen atoms would be fully ten times more abundant than all the rest (depending on the average weight of the heavy atoms).

If helium is present, the proportions of hydrogen and heavy atoms both diminish, but the numerical preponderance of hydrogen persists. Hydrogen is not only the simplest atom: it is the one whose transformation into other elements liberates by far the most energy and is irreversible. The great and almost invariable preponderance of hydrogen may therefore be taken as strong evidence that our universe is still young.

## OBITUARY

### HUGH McCORMICK SMITH

EARLY in the morning of September 28, 1941, Dr. Hugh McCormick Smith died suddenly of a heart attack after an illness of a few hours. He was seventy-five years of age.

Dr. Smith was born on November 21, 1865, in Washington, D. C., son of Thomas Croggon and Cornelia Hazard Smith. He began his natural history studies when a small boy, owing largely to his father's interest in birds and other small animals on his farm in Virginia. He attended Central High School, D. C., was first president of its Natural History Society, graduating in 1884. In 1888 he graduated in medicine with a perfect record in all oral and written examinations from Georgetown University Medical School and was a member of its staff from 1888 to 1905.

On March 12, 1889, Dr. Smith married Emma Hanford. Their daughters are Mrs. Edmund Vincent Cowdry of St. Louis and Mrs. Carl Harry Claudy, Jr., of Washington.

Dr. Smith's interest in science was guided while he was in high school by Professor Spencer F. Baird, the latter giving him the opportunity to work in the National Museum in 1884-85. He entered the service of the U. S. Fish Commission under Commissioner Baird in 1886, and during the next six years had six promotions. From 1893-1897 he was assistant in charge, division of statistics and methods of the fisheries of the U. S. Fish Commission and during the next five years Smith was assistant in charge, division of inquiry respecting food fishes and the fishing grounds.

From 1903 to 1913 Dr. Smith was deputy commissioner of the Bureau of Fisheries, a position especially created by Congress and from 1913 to 1922 he was the Commissioner of Fisheries. In 1900 he was named to

represent the United States at the First International Fishery Congress, Paris; and again in 1905, the Third International Fishery Congress at Vienna. He was secretary-general at the Fourth International Fishery Congress, Washington, in 1908.

Smith held several positions of honor such as secretary, National Fishery Congress, 1898; chairman, International Jury on Fish Culture, Louisiana Purchase Exposition, 1904; expert adviser of the Food and Drugs Board and of the Bureau of Chemistry in fishery cases arising under the Pure Food and Drugs Act of 1906-1913; expert special assistant of the United States Counsel at the Arbitration of the North Atlantic Fisheries Dispute at The Hague, 1910; United States Government representative of the International Commission for Adjudication of Fishery Disputes with Canada and Newfoundland arising under the award of The Hague arbitration tribunal, 1910; representative of the United States on the Permanent International Council for the Exploration of the Sea, 1912; member of the research committee and associate editor, National Geographic Society, 1909-1919; commissioner on behalf of the United States on International Fishery Commission for regulation of fisheries in boundary waters of the United States and Canada, 1914.

Dr. Smith was director of the Marine Biological Laboratory of the U. S. Bureau of Fisheries, Woods Hole, Mass., 1901-1902, and director of the *Albatross* expedition for investigation of fisheries and aquatic resources of the Philippine Islands, 1907-1910.

From 1900 to 1934 he studied the aquatic resources and the fisheries, as well as inspected methods of fish culture, some of the laboratories, biological investigations and fishery administrations in 22 foreign countries in Europe, South America and Asia. The exten-

sive collections made by Dr. Smith in these various lands and adjoining seas were given to various museums, but mostly to the United States National Museum.

In honor of his contributions to science, four birds, two reptiles, one amphibian, nine fishes, three mollusks, two crustaceans, two insects and three other forms have been named after him. From 1898 to 1931 he was presented with seven medals in recognition of his achievements and services.

Dr. Smith's chief contributions to science occur in the fields of ichthyology and fisheries science. In the latter field he spent 36 years with the United States Fish Commission publishing about one hundred papers on fishery science and a somewhat larger number on ichthyology have appeared under his pen, describing numerous new species, new genera and families of fishes. Among a total of about 300 published papers by him there are one or more in nearly all fields of natural history. Since 1925 his published researches have been largely on fishes and other animals from Siam, now Thailand, where from 1923-1935, as advisor in Fisheries to His Siamese Majesty's Government, organizer of the Siamese fishery service, and first director of the fishery bureau, he had ample opportunity to collect and study the fauna of Thailand.

His interest in Siamese fishes was so great that upon his return to the United States he began the most important scientific contribution of his life, "A Monograph of the Freshwater Fishes of Siam." For the last six years this monumental work with about 300 illustrations has occupied all his time in the Division of Fishes, U. S. National Museum, where he was associate curator in zoology.

Although his untimely death has left the Siamese manuscript not quite completed it is hoped that it can be put in shape for publication by one of his numerous ichthyological friends.

LEONARD P. SCHULTZ

U. S. NATIONAL MUSEUM

## RECENT DEATHS

DR. JOHN STANLEY PLASKETT, who retired in 1935 as director of the Dominion Astrophysical Observatory at Victoria, B. C., died on October 17 at the age of seventy-six years.

DR. JAMES ALLEN NELSON, for some years research entomologist in the Department of Agriculture at Washington, who had retired from active service, died on August 9 at the age of sixty-five years.

PROFESSOR JAMES TROOP, state entomologist of Indiana from 1899 to 1907, later head of the department of entomology and horticulture at Purdue University, died on October 14 at the age of eighty-eight years.

DR. LOUIS FAUGERES BISHOP, clinical professor of heart and blood vessel disease at Fordham University, died on October 6 at the age of seventy-seven years.

PROFESSOR HARRY SLOAN HOWER, head of the department of physics at Carnegie Institute of Technology, died on October 10 at the age of sixty-four years. He had been a member of the faculty since 1906.

DR. HANS SPEMANN, professor of zoology at the University of Freiburg, Germany, died on September 12.

*Nature* reports the death of Professor A. G. Green, formerly professor of tinctorial chemistry in the University of Leeds and director of research to the British Dyestuffs Corporation, on September 12, aged seventy-seven years; of Dr. W. Gardiner, honorary fellow and formerly fellow and bursar of Clare College, lately university lecturer in botany in the University of Cambridge, on August 31, aged eighty-one years; of Dr. A. K. M. Noyons, professor of physiology in the University of Utrecht, aged sixty-three years; and of Dr. E. Abelaus, formerly professor of physiology in the University of Toulouse.

## SCIENTIFIC EVENTS

### RESULTS OF THE ECLIPSE EXPEDITION OF 1940

A REPORT of the results of the National Geographic Society-National Bureau of Standards Eclipse Expedition of 1940 was presented at the meeting of the Washington Philosophical Society on October 11. The expedition was stationed at Patos, in the state of Paraiba do Norte of Brazil, this location being north and west of Recife. The eclipse was on October 1. The program of scientific work planned for this expedition was so varied in nature that results of considerable scientific importance were obtained, although

a thin veil of clouds partially obscured the eclipse during the period of totality. Dr. Irvine C. Gardner, the leader of the expedition, described the new corona cameras, polarigraphs and spectrographs which were specially designed and constructed for use at this expedition. Dr. Paul A. McNally, S.J., of the Georgetown College Observatory, reported on measurements of the times of contacts determined from photographs of the partial phases. Dr. E. O. Hulburt, of the Naval Research Laboratory, gave the results of measurements of sky brightness made during twilight and during the period of darkening by the eclipse.

From these measurements deductions were made regarding the temperature prevailing in the uppermost layers of the atmosphere. Dr. C. C. Kiess, of the National Bureau of Standards, obtained an excellent flash spectrum and presented the results of photographic photometric measurements of the relative intensities of the members of the Balmer series and other groups of related lines. T. R. Gilliland, also of the National Bureau of Standards, obtained measurements of the effective heights of the ionosphere during the total and partial phases of the eclipse. Colored motion pictures, made by Richard H. Stewart, of the National Geographic Society, showed the work of the expedition at the eclipse site.

### THE ENGINEERS' DEFENSE BOARD

THE establishment of the Engineers' Defense Board, a new working organization of engineers and technologists from the several national engineering societies to deal with technical problems on shortages, substitutions, conservation, raw materials, production and reclamation in the nation-wide adjustment under the impact of the defense effort, was reported in last week's issue of *SCIENCE*. Members of the board include:

*American Society of Civil Engineers:* Carlton S. Proctor, consulting engineer, executive committee representative; Richard E. Dougherty, vice-president, Improvements and Developments, New York Central System; Charles F. Goodrich, chief engineer, American Bridge Company; Robert R. McMath, chairman of the board, Motors Metal Manufacturing Company; J. P. H. Perry, vice-president, Turner Construction Company.

*American Institute of Mining and Metallurgical Engineers:* John F. Thompson, executive vice-president, International Nickel Company, executive committee representative; Zay Jeffries, technical director, Lamp Department, General Electric Company; Wilbur Judson, vice-president, Texas Gulf Sulphur Company; Frederick Laist, metallurgical manager, Anaconda Copper Mining Company; Wilfred Sykes, president, Inland Steel Company.

*American Society of Mechanical Engineers:* R. M. Gates, president, Air Preheater Company, executive committee representative; H. V. Coes, Industrial Department, Ford, Bacon and Davis, Inc.; K. H. Condit, dean of engineering, Princeton University; J. W. Parker, vice-president and chief engineer, Detroit Edison Company; W. R. Webster, chairman of board, Bridgeport Brass Company.

*American Institute of Electrical Engineers:* H. H. Barnes, Jr., General Electric Company, executive committee representative; C. A. Adams, E. G. Budd Manufacturing Company; C. B. Jolliffe, Radio Corporation of America; R. L. Jones, Bell Telephone Laboratories; Phillips Sporn, vice-president in charge of engineering, American Gas and Electric Service Corporation.

*Society of Automotive Engineers:* C. L. McCuen, vice-

president and chief engineer, General Motors Corporation, executive committee representative; Rex B. Beisel, chief engineer, Vought-Sikorsky Aircraft Corporation; C. E. Frudden, Allis Chalmers Company; Arthur Nutt, vice-president, Wright Aeronautical Corporation; James C. Zeder, chief engineer, Chrysler Corporation.

*American Institute of Chemical Engineers:* F. W. Willard, president, Nassau Smelting and Refining Company, executive committee representative; Webster Jones, Carnegie Institute of Technology; R. L. Murray, vice-president, Hooker Electrochemical Company; A. J. Weith, manager of research, Bakelite Corporation; R. E. Wilson, president, Pan American Petroleum Transport Company.

Serving as officers of the Engineers' Defense Board are Robert E. McConnell, OPM consultant, *chairman*; Dr. Harry Rogers, president of the Polytechnic Institute of Brooklyn, *vice-chairman*, and Dr. A. B. Parsons, secretary of the American Institute of Mining and Metallurgical Engineers, *secretary*.

### THE "B-COMPLEX" AWARD OF MEAD JOHNSON AND COMPANY

NOMINATIONS are solicited for the 1942 award of \$1,000 established by Mead Johnson and Company to promote researches dealing with the B-complex vitamins. The recipient of this award will be chosen by a Committee of Judges of the American Institute of Nutrition and the formal presentation will be made at the annual meeting of the institute at Boston on April 1.

The award will be given to the laboratory (non-clinical) or clinical research worker in the United States or Canada who, in the opinion of the judges, has published during the previous calendar year, January 1 to December 31, the most meritorious scientific report dealing with the field of the "B-complex" vitamin. While the award will be given primarily for publication of specific papers, the judges are given considerable latitude in the exercise of their function. If in their judgment circumstances and justice so dictate, it may be recommended that the prize be divided between two or more persons. It may also be recommended that the award be made to a worker for valuable contributions over an extended period, but not necessarily representative of a given year. Membership in the American Institute of Nutrition is not a requisite of eligibility for the award.

To be considered by the committee, nominations for this award for work published in 1941 must be in the hands of the secretary of the American Institute of Nutrition, Arthur H. Smith, Wayne University College of Medicine, Detroit, Mich., by January 10. The nominations should be accompanied by such data relative to the nominee and his research as will facilitate the task of the committee in its consideration of the nomination.

### THE 1941 RUMFORD AWARD OF THE AMERICAN ACADEMY OF ARTS AND SCIENCES

IN 1797, the erstwhile American, Benjamin Thompson, then Count Rumford of Bavaria, sent to John Adams, president of the American Academy of Arts and Sciences, the sum of five thousand dollars. Rumford requested that the income of this fund be used to award, every two years, a gold and a silver medal to a worker in America who had made, in the opinion of the academy, outstanding contributions to the subject of heat or light. The first award was made to Robert Hare in 1839 for his invention of the compound or oxyhydrogen blowpipe.

The American Academy of Arts and Sciences has recently awarded the Rumford medals to Dr. Vladimir Kosma Zworykin, associate director of the Research Laboratories of the Radio Corporation of America. He is an expert in photocells and their application, has played a major rôle in the development of television, assisted materially in the development of the electron microscope and is the writer of many scientific papers. His entire record is such that the academy feels fully justified in selecting Dr. Zworykin as the latest recipient of this honor.

The citation made by Professor Norton A. Kent, chairman of the Rumford Committee of the American Academy of Arts and Sciences, follows:

Born in Russia, educated in the Petrograd Institute of Technology and the Collège de France, Paris; a naturalized citizen of the United States; a doctor of philosophy of the University of Pittsburgh; associated with the R.C.A. Manufacturing Company since 1929 and associate director of the R.C.A. research laboratories since 1934; recipient of the Morris Liebmann Memorial Prize in 1934 and the Modern Pioneer Award in 1940; inventor of the Iconoscope—the instrument which forms the very core of the complicated mechanism at the television transmitting station, and director of a group of men responsible for its development; holder of a number of patents relating to the Kinescope—the receiving device in television; inventor, also, of the electron multiplier and many devices in electronics; writer of various scientific papers.

Dr. Vladimir Kosma Zworykin, to you the American Academy of Arts and Sciences will award the Rumford Medals to-night [October 8].

You and we are parts of a great fraternity, membership in which transcends the bounds of nationality—the Society of Scientific Men.

Years ago this country welcomed you to its shores. Your life with us has borne fruit of immense value to the people of your adopted land.

It is with high regard and great pleasure that the members of the Rumford Committee offer your name to the academy as that of the Rumford Medalist of 1941, these medals being awarded to you for your "Invention of the Iconoscope and other Television Devices."

### DR. JESSUP SUCCEEDS DR. KEPPEL AS PRESIDENT OF THE CARNEGIE CORPORATION

DR. FREDERICK P. KEPPEL, since 1922 president of the Carnegie Corporation of New York, will retire on November 18. Though Dr. Keppel will not be charged with administrative duties after that date, he will remain as educational adviser to the corporation.

The Carnegie Corporation of New York, under the leadership of Dr. Keppel, has devoted during his nineteen-year administration more than \$150,000,000 to the promotion of education in the United States and the British Dominions and Colonies. Funds have been provided for specific undertakings and long-time projects in the fields of library service, fine arts, scientific and educational research, general education and for colleges and universities.

In professional fields, large grants have been made to the American Law Institute; to Columbia, Chicago, North Carolina and Atlanta universities; to library schools, and to the American Library Association; more than \$3,000,000 for the extension and development of library services throughout the United States; to Harvard University, \$1,000,000, for the development of its School of Dental Medicine; to other agencies, varying amounts, for the study of education in medicine, architecture, forestry, dentistry, fine arts teaching and for the effectiveness of teaching modern languages and the social sciences.

The Carnegie Corporation of New York, chartered in 1911 by the New York State Legislature, was created by Mr. Carnegie as his largest and final trust in this country, "to promote the advancement and diffusion of knowledge and understanding among the people of the United States." Its total resources are more than \$165,000,000, annual expenditures have averaged over \$5,000,000, and it has granted more than \$182,000,000 in its thirty years of work.

Dr. Walter A. Jessup, since 1934 president of the Carnegie Foundation for the Advancement of Teaching, will succeed Dr. Keppel as president of the corporation on November 18. He has been a trustee of the corporation since 1934, a member of its executive committee and a trustee of the Carnegie Institution of Washington since 1938.

With election to the presidency of the Carnegie Corporation, Dr. Jessup becomes chief executive officer of two separate philanthropies, each of which has its own board of trustees, offices and functions. Under his presidency the two bodies continue as distinct corporate entities, without modification of the role of either. Dr. Jessup's work in the dual capacity recalls the arrangements under which in 1921-23 Dr. Henry S. Pritchett was at the head of the corporation and of the foundation, and in 1919-21, Edwin Root

presided both over the Carnegie Endowment for International Peace and the Carnegie Corporation of New York.

The two endowments of which Dr. Jessup becomes president were both founded by Andrew Carnegie during his lifetime. The Carnegie Foundation for the Advancement of Teaching, organized in 1905, was incorporated by Act of Congress one year later. Its chief purpose is providing retiring allowances and widows' pensions in universities, colleges and tech-

nical schools in the United States, Canada and Newfoundland. It has also conducted and published studies of medical education, the relations of higher and secondary education in Pennsylvania, college athletics, legal and dental education and teachers' pensions and other educational matters. Its resources are about \$21,000,000, its annual expenditure for free pensions about \$1,900,000, while grants for pensions since 1905 have amounted to more than \$40,600,000.

## SCIENTIFIC NOTES AND NEWS

THE gold Sedgwick Memorial Medal "for distinguished service in public health," of the American Public Health Association, was presented at the Atlantic City meeting to Dr. Charles Armstrong, senior surgeon of the U. S. Public Health Service and investigator at the National Institute of Health, in recognition of "research on the transmission of sleeping sickness, parrot fever and infantile paralysis." Other recipients of the medal have been the late Professor Hans Zinsser, of Harvard University, for his work on typhus; the late Dr. Theobald Smith, distinguished for his work on the comparative pathology of infectious and parasitic disease, and Dr. Haven Emerson, professor of public health administration at the College of Physicians and Surgeons, Columbia University. The medal was established as a memorial to the late Professor William Thompson Sedgwick, of the Massachusetts Institute of Technology.

JOHN C. GARAND, of the Springfield Armory, inventor of the semi-automatic rifle being used by the Army and by the Marine Corps, has been awarded the Holley Medal of the American Society of Mechanical Engineers for his "contributions to our national defense." The medal will be presented to Mr. Garand on December 3 at the annual dinner of the society in New York.

THE Honorable Fulgencio Batista, President of Cuba, issued a decree on July 12 awarding honorary membership in the Finlay Institute to Dr. Morton C. Kahn, associate professor of public health and preventive medicine, and to Dr. Edgar Mayer, assistant professor of clinical medicine at the Cornell University Medical College, New York, in recognition of their efforts on behalf of the Cuban Republic.

THE Gold Medal of the British Medical Association has been awarded to Sir Kaye Le Fleming, in recognition of his distinguished work for the association and the profession.

L. F. MARGAM, of the University of the Wit-

watersrand, has been elected president of the South African Museums Association.

DR. LLEWELLYN R. PERKINS, head of the department of mathematics at Middlebury College, resigned on October 14 because of ill health.

DR. SVEIN ROSSELAND, astrophysicist, formerly of the University of Oslo, has been appointed professor of astronomy at Princeton University, succeeding the late Dr. Raymond S. Dugan.

V. E. KIVLIN, director of the farm short course at the University of Wisconsin, has been appointed assistant dean of the College of Agriculture. He will succeed Dr. Ira L. Baldwin, who resigned to become chairman of the department of agricultural bacteriology.

A ROCKEFELLER FOUNDATION grant of \$25,000 has been made to McGill University for research in endocrinology for five years under the direction of Dr. J. S. L. Browne, assistant professor of medicine and lecturer in pathological chemistry.

JOHN R. MATCHETT, chemist of the Bureau of Narcotics of the U. S. Treasury Department, who has been engaged in marahuana research, has joined the U. S. Department of Agriculture and has been assigned to the research laboratory at Albany, California.

DR. EARL N. BRESSMAN, who has been assistant director of Federal Agricultural Research, has been placed at the head of the Division of Agriculture established by Nelson Rockefeller, coordinator of Inter-American Affairs.

DR. CHARLES F. KREWSON, since 1927 a member of the faculty at the University of Kentucky, has resigned to accept a position with the U. S. Government as research chemist in the eastern regional research laboratory of the U. S. Department of Agriculture. Dr. James L. Gabbard and Dr. R. H. Baker have resigned from the University of Kentucky to join re-

spectively the faculty of the Michigan State Normal School and of Northwestern University.

ROBERT W. CAIRNS, assistant to the director of research of Hercules Powder Company, has been appointed director of the Hercules Experiment Station at Wilmington, Del.

DR. HARRY W. REDDICK, head of the department of mathematics at Cooper Union, has been granted leave of absence to enable him to become director of the Defense Training Institute, Brooklyn, N. Y., to succeed Professor Sampson K. Barrett, of the College of Engineering of New York University. The institute is conducted jointly by the eight engineering colleges of New York City. It is supported by the U. S. Office of Education and is designed to give free training to alleviate the shortage of sub-professional engineers in defense industries.

DR. HAMILTON H. ANDERSON reached China about September 15 to resume his work as professor of pharmacology at the Peiping Union Medical College. He spent the summer in research on parasitic diseases found in China in the laboratories of the Division of Pharmacology of the University of California.

MYRON WEISS, New York consulting editor, has become science warden of *Physical Culture* and editorial adviser to the General Alloys Company of Boston.

DR. HENRY WIGDERSON, instructor in surgery at New York University, has been appointed to the newly established position of head neuro-surgeon in the Rothschild-Hadassah-University Hospital on Mount Scopus, near Jerusalem.

DR. C.-E. A. WINSLOW, professor of public health at the Medical School of Yale University, who was during the fall semester Rosenberg lecturer in the Public Social Services at the University of California, gave two lectures before the faculty and senior students at the Medical School, one on "Modern Public Health Programs" and the other on "Medical Care in Modern Society."

PROFESSOR T. R. HOGNESS, University of Chicago, addressed a meeting of the New York Branch of the American Chemical Society on the evening of October 10 on "The Hydrogen Transport System of the Respiratory Enzymes."

KARL P. SCHMIDT, chief curator of zoology at the Field Museum of Natural History, Chicago, addressed the University of Cincinnati Section of Sigma Xi on October 9. His lecture was entitled "A Naturalist's Glimpse of Peru."

UNDER the auspices of the Faculty of Medicine of Harvard University three lectures on the Edward K. Dunham Lecture Foundation for the Promotion of the

Medical Sciences will be given at five o'clock on October 28, 29 and 30 on "Problems in Intermediary Metabolism." The titles of the individual lectures are "The Chemical Reactions of the Body Fats," "The Chemical Reactions of the Body Proteins," "The Dynamic State of the Body Constituents." The lectures were prepared by the late Dr. Rudolf Schoenheimer, formerly associate professor of biological chemistry at Columbia University, and will be delivered by Professor Hans T. Clarke, professor of biochemistry and head of the department at the College of Physicians and Surgeons, Columbia University.

IN the article by George Y. McClure in *SCIENCE* of September 26, 1941, on page 308, sixth line, second column, delete "and human."

AT its annual meeting each year the American Association for the Advancement of Science awards a limited number of grants-in-aid of research. Forms for use in filing applications for grants can be obtained from the office of Dr. F. R. Moulton, the Permanent Secretary, Smithsonian Institution Building, Washington, D. C. In order that applications may be considered at the meeting in Dallas next December 29-January 2, they should be received before December 1.

THE nineteenth annual meeting of the American Orthopsychiatric Association, an organization for the study and treatment of behavior and its disorders, will be held at the Hotel Statler, Detroit, on February 19, 20 and 21. Copies of the preliminary program will be sent upon request.

THE fifty-second annual meeting of the Association of American Medical Colleges will be held in Richmond, October 27 to 29, with the Medical College of Virginia as host.

ACCORDING to the Associated Press, a Reuter dispatch from Stockholm dated October 17 reports that the Swedish Government has decided that Nobel Prizes should not be awarded this year.

*Chemical and Metallurgical Engineering*, New York, has given to the Dow Chemical Company the 1941 award "for chemical engineering achievement based on its research in the recovery of metallic magnesium from sea water, which, in the opinion of the committee of award, has contributed the most meritorious advance to the industry and profession since December, 1939." Presentation of the award will be made at a dinner in New York on December 2 at the eighteenth National Exposition of the Chemical Industries at the Grand Central Palace.

FOR the academic year 1941-1942 the Abbott Laboratories have established fellowships in several uni-

versities with important departments of organic chemistry and biochemistry. The fellowships, carrying stipends of \$650, have been made available to graduate students in the last year and next to last years of graduate work leading to the doctor's degree. The recipients have been selected by the universities in which their work is being done, and they are not limited by the fellowships as to the subjects of their investigation. Grants have been made to the following universities: Illinois, Michigan, Ohio State, Pennsylvania State and Purdue, in organic chemistry; Columbia and Cornell, in biochemistry.

THE Byrd Antarctic Expedition has moved its scientific headquarters from Boston to Miami University. The lower wing of the university hospital has been assigned for the use of the expedition, where the compiling of the scientific reports of the expedition, which returned last summer, will be coordinated.

WORKS PROGRESS ADMINISTRATION workers are constructing a research laboratory for aerodynamic courses at Purdue University Airport (Indiana), where graduate engineers can study aeronautical engineering for both military and civil life. Last semester at Purdue University, fifty engineers received this type of training, using existing facilities. The new laboratory is an addition to the university's airport building. During the past year, nearly three hundred students were given primary flight training and twenty others advanced flying courses at the airport.

THE New York Zoological Park will conduct for permanent exhibition purposes a farm of four acres completely equipped with live stock and machinery, the cost of which will be \$380,000. The site is on an undeveloped area of the Zoological Park lying east of Boston Road. Two large buildings are under erection as the center of the farm. The animal house is an "L" shaped building with stalls and pens for cattle, horses, sheep and goats. The other building is of "U" shape design. It will have a greenhouse in one wing and a poultry house in the other. A garage, office and storage space will line the two wings; an octagonal tower, in which it is planned to display agricultural exhibits, will join the poultry house wing. The

buildings are being constructed in stone, and will resemble the farmhouses of Normandy in France.

THE fiftieth anniversary of the founding of Drexel Institute of Technology will be observed during the college year 1941-42, with Founder's Day ceremonies in December and special observances throughout the year. The anniversary commemorates the founding of the institute in 1891 by Anthony J. Drexel, banker-philanthropist, assisted by George W. Childs, publisher of the *Philadelphia Ledger*. It has grown from a technical school of 1,600 day and evening students to its present enrolment of over 5,000 for professional training.

ACCORDING to *Nature*, Imperial Chemical Industries proposes to publish a new quarterly journal of science, and it is hoped that the first number will appear during the autumn of this year. The journal will be translated into at least three foreign languages and will circulate in all parts of the civilized world. Though published by Imperial Chemical Industries, it will in no sense be an advertising medium, but, by laying principal emphasis upon British contributions to science, will form part of the national war effort. Distinguished men of science have already expressed their willingness to contribute, and the chief article of the inaugural number will be by the Astronomer Royal, Dr. H. Spencer Jones.

THE Academy of Sciences of the U.S.S.R. will issue a new work entitled "Soviet Folk-lore," into the compilation of which has gone much effort on the part of many expeditions to different parts of the Soviet Union. An expedition sent out to the Stalingrad Province by the University of Leningrad has collected much interesting material relating to the folk-lore of the Don Cossacks. In the villages and farmsteads of that province the expedition recorded 110 folk-tales, 550 Cossack songs, as well as numerous proverbs and legends. Among the songs are some about Stepan Razin, Yermak, Peter the Great and the War of 1812. This expedition has also collected interesting material relating to the new Soviet folk-lore of the Don Cossacks. Records were made of songs and tales on the subjects of Stalin, Voroshilov, Budenny, the Civil War and the collective farm.

## DISCUSSION

### COLLEGES AND THE CHANGING HIGH SCHOOLS

A RECENT survey of the teaching of physics in Pennsylvania high schools<sup>1</sup> has yielded some results and shown some trends which may be of interest to a wider group than college physics teachers alone.

<sup>1</sup> M. H. Trytten and J. M. Leach, *Am. Jour. Phys.*, March, 1941.

The study was undertaken as a result of a series of discussions and papers at various meetings of college physics teachers in Pennsylvania. Such discussions, in common with similar ones in other states, aired a conviction that the teaching of physics in high schools appeared to leave no great influence on those entering college. It was stated that one can scarcely detect whether a student in college physics has had a

course in high-school physics or not. Usually the blame was laid to insufficient training in physics on the part of the teacher. It was felt that if the teachers of physics could be adequately trained then the high-school course must yield better and more permanent results. It was to determine the facts not only as to the training of teachers but also other pertinent and significant information about them and their courses that this study was undertaken.

No attempt to describe the method of the study nor to cover in full the results will here be made. A complete report is available to those who care for it. Only those results will be given which are of interest in connection with the two main points of this paper—why the teacher seems ineffective and what seems indicated by the study concerning the future of the teaching of science in the schools.

The results of the survey showed that the teachers of physics are inadequately trained. Actually 2 per cent. of the teachers surveyed had had no courses in physics at all; 4 per cent. had had only from one to five hours; 38 per cent. had approximately the equivalent of a college course or less (from six to eleven hours); or adding the three groups, 44 per cent. had had eleven hours of college physics or less. Only 12 per cent. had had as much as a physics major of twenty-four hours. Only 16 per cent. had had any graduate work in physics. And yet almost one third of the teachers had master's degrees—indicating that when pursuing further study almost invariably is the work done in other fields.

The experience of the teachers is surprisingly small. Over half have no more than five years' experience, and actually 14 per cent. have only one year's experience, indicating a high turn-over in this field. Thirty per cent. have over ten years' experience. Among these, however, are a great number who have much administrative work or who coach. Actually 41 per cent. of all physics teachers either serve as coaches or as administrators.

A third very significant matter is the size and nature of the teaching load, including outside activity. Only 6 per cent. of physics teachers teach physics exclusively. Of these some are engaged in administration or coaching so that 4 per cent. only may be thought of as full-time physics teachers. The rest teach combinations of physics with chemistry, with general science, etc. Some teachers teach seven different subjects. Only 30 per cent. teach as little as two other subjects. Most teachers have heavy outside activities such as acting as advisers for various types of clubs or student endeavors.

The picture one gets here of the typical teacher shows him teaching almost a full schedule of assorted sciences, and yet sponsoring an after-hours activity.

It would be difficult to present one dynamic laboratory program under these conditions. The average teacher has three sciences and hence three laboratories to keep up.

A movement is apparently gathering momentum to attempt to improve the quality of physics teaching by increasing the preparation of the teacher. It would seem that in Pennsylvania the sciences should cooperate to lay out an adequate program of teacher training, recognizing that most teachers will teach a combination of sciences. And likewise it would seem that the emphasis in teacher training should shift from the purely professional courses over toward more work in the field to be taught, and this particularly in the post-graduate field. Added courses taken for purposes of certification should not all be in the field of education.

But perhaps more interesting results, at least as far as trends are concerned, come out of the study of the high-school physics course itself.

Enrolment is on the decrease. The U. S. Office of Education<sup>2</sup> states that in 1910 physics was studied by 14.6 per cent. of the high-school enrolment, while in 1928 this had dropped to 6.9 per cent. From 1922 to 1938 high-school enrolment increased 35 per cent. while physics enrolment increased but 6 per cent.<sup>3</sup> By 1934 physics enrolment was down to 6.3 per cent. In Pennsylvania in 1938-1939 only 5 per cent. of the total enrolment studied physics.<sup>4</sup>

The enrolment, when considered in connection with the size of the high schools, showed some interesting things. Large schools where a wide diversity of courses is offered have the lowest enrolment in physics. The small school apparently stays conservative until the pressure forces a complete change, involving the dropping of traditional courses entirely. Thus physics has been dropped in 4 per cent. of high schools. Also the physics course is becoming in all schools much more qualitative and the aim is to cater to non-college preparatory groups. The laboratory is retreating.

To scientists in general the plight of high-school physics may seem a special case. But it is much more probably a barometer. It is admittedly a more vulnerable subject, since it demands mathematics as a prerequisite (or used to, since now only 60 per cent. of physics courses in high school demand mathematics as a background). Yet the problem which faces physics faces all sciences and all other academic subjects. The high schools are fast finding it necessary to cater to the vast majority rather than the small college-bound group. After all, only 10 per cent. more or less of high-school students go to college. There is a very rapidly accelerating movement in the direction

<sup>2</sup> F. M. Phillips, U. S. Office of Education Bulletin, number 35, 1929.

<sup>3</sup> Jessor and Herlihy.

<sup>4</sup> Morneswick.

of such a change in aim. It will undoubtedly produce a new type of school, aimed at the average person, a sort of folk high school and far from the old college-dominated school of the last generation.

As an example of the trend Dr. S. R. Powers,<sup>5</sup> of Columbia University, describes the results of a five-year survey of science teaching in high schools and explains plans for a three-year experimental plan to be carried out in several large cities. Dr. Powers states that the conventional treatment of sciences and other subjects will go by the board. Instead "scrambled" courses will be given. "It is not necessary to clutter the mind with equations," says Dr. Powers. "Students will pick up what they need to know later in life." Of course "vexing questions may arise when college entrance credits must be met, but that is a minor question." This study will be financed, and has been, by a \$160,000 grant from the General Education Board.

Whatever orthodox college faculty men may think of such a business as this, the fact is they must recognize that the high school is in a state of flux. The pressure on it to change its aims and methods, more nearly to serve the average graduate, will increase. And the college preparatory student will be forced to take pot luck with the crowd. Diluted courses, "scrambled" courses, survey courses, are the new dish to be served up.

It is into this apparently insoluble problem that the college man needs to peer in the hope of finding a way out. The more the high school aims at the average terminal student the less can it prepare efficiently a well-trained recruit for the college. The very largest high schools might segregate the two groups and attempt to serve each separately, but it is not now being done in most cases nor does it seem likely. At any rate the smaller schools which handle the greater percentage of the students could not serve two ends. If the college-bound student represents the future leadership in all branches, as seems obvious, then it is surely too bad to condemn him to four years at half speed, as seems inevitable in the future.

Perhaps separate technical high schools, not only in cities, but in rural areas also, are the answer. That is a matter to be worked out. It seems very definite that the colleges must expect less well-trained material entering the freshman classes as the emphasis in high school shifts from the traditional goal, unless something is done to meet the needs of the better but smaller and more important group of potential leaders who go on to college.

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<sup>5</sup> *New York Times*, January 19, 1941, p. 6D.

## P-AMINO BENZOIC ACID, AN ESSENTIAL METABOLITE FOR AUTOTROPHIC ORGANISMS

It was earlier shown that p-aminobenzoic acid nullifies the inhibitory effect of sulfanilamide and its derivatives on the growth of bacteria as well *in vitro* (Woods, Fildes<sup>1</sup> and others) as *in vivo* (Selbie<sup>2</sup> and others). As an explanation of this fact it was suggested that p-aminobenzoic acid is a necessary factor in the metabolism of these organisms: an essential metabolite according to Fildes.<sup>3</sup>

A similar effect of p-aminobenzoic acid was also shown in experiments *in vivo* with the virus of Lymphogranuloma venereum by Findlay.<sup>4</sup>

Recently Ansbacher<sup>5</sup> and Martin<sup>6</sup> gave experimental evidences indicating the importance of p-aminobenzoic acid as a chromotrichial factor in rats and mice and further as a growth promoting factor in chicks, which made Ansbacher consider the p-aminobenzoic acid to be a vitamin, belonging to the B complex.

The significance of p-aminobenzoic acid, however, does not seem to be limited to the animals and bacteria just mentioned. Experiments conducted in the Bacteriological Laboratory of the Swedish State (Stockholm) indicate that p-aminobenzoic acid is of the same importance to autotrophic plants as to the heterotrophically living bacteria. In experiments with two strains of the small fresh-water diatom *Nitzschia palea* var. *debilis*, which were grown on an agar made up with tap-water and mineral salts (cfr. Wiedling<sup>7</sup>), an inhibition of the effect of sulfonamide and its derivatives (sulfapyridine and sulfathiazol) was produced by p-aminobenzoic acid.

Evidently there are reasons to interpret these experiences as indicating that p-aminobenzoic acid is of a universal significance in the metabolism of plants, both autotrophic and heterotrophic, and perhaps also in the metabolism of animals and viruses.

Detailed data will appear later.

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## CULEX QUINQUEFASCIATUS, A NEW VECTOR OF PLASMODIUM GALLINACEUM

*Plasmodium gallinaceum* Brumpt, 1935, the cause

<sup>1</sup> D. D. Woods and P. Fildes, *Chem. Ind.*, 59: 133, 1940.

<sup>2</sup> F. R. Selbie, *Brit. Jour. Exp. Path.*, 21: 90, 1940.

<sup>3</sup> P. Fildes, *Lancet*, 238: 955, 1940.

<sup>4</sup> G. M. Findlay, *Brit. Jour. Exp. Path.*, 21: 356, 1940.

<sup>5</sup> S. Ansbacher, *Science*, 93: 164, 1941.

<sup>6</sup> G. J. Martin and S. Ansbacher, *Jour. Biol. Chem.*, 138: 441, 1941.

<sup>7</sup> S. Wiedling, *Bot. Not.*, 87, 1941.

of malaria of fowls, is transmitted by *Aedes aegypti* and *A. albopictus* (Brumpt, 1936),<sup>1</sup> as well as by *Aedes gemiculatus* (Roubaud, Colas-Belcour and Mathis, 1939).<sup>2</sup> *Culex fatigans*, *C. pipiens* and *Culex* sp. (Richelieu, Indre-et-Loire, France) tested by Brumpt (1936) proved to be refractory to infection by this plasmodium. We do not know of any other mosquito reported to date as a vector of this species of *Plasmodium*.

Recently, in a lot of *Aedes aegypti* which had been released to feed on chickens infected with *Plasmodium gallinaceum*, there was accidentally introduced a specimen of *Culex quinquefasciatus* from Iguala, Gro. that emerged in another lot of this species raised in the laboratory. On dissecting this insect, abundant sporozoites were found in its salivary glands. The mosquitoes had fed for the first time 29 days before on chickens infected with *Plasmodium*. They had been kept at ordinary laboratory temperatures approximating 20–25 degrees Centigrade.

In view of the abundance of this species of mosquito in the country, and in view of the negative results obtained previously in attempts to infect species of the genus *Culex*, it seems important to submit a preliminary report of our findings in this case of infection, which to date is the only one recorded.

Experiments are at present under way in this Institute to determine the susceptibility of this species of *Culex* to infection by *Plasmodium gallinaceum*, as well as to determine the possibility of finding other vectors among mosquitoes of the region.

LUIS VARGAS  
ENRIQUE BELTRÁN

INSTITUTO DE SALUBRIDAD Y  
ENFERMEDADES TROPICALES,  
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#### POLISHED AREAS ON GRANITIC PORPHYRIES OF THE HUECO AND CORNUDAS MOUNTAINS OF TEXAS AND NEW MEXICO<sup>1</sup>

RECENTLY while engaged in making geologic observations in the Hueco and Cornudas Mountains of western Texas and New Mexico I became aware of the repeated occurrence of large highly polished patches of rock which had escaped my notice before this. The Huecos and Cornudas, like other granitic intrusive masses, upon weathering have developed large open fractures, niches and even sizable caves, many of which have openings at the level of the

ground. There was observed at the entrance to one of these small crevice caves a highly polished rock surface on the hanging-wall side. The footwall, however, showed the same rough weathered appearance as the inner and outer surface about the polished area. Subsequently it was found that at practically all other slanting cavernous openings, the polished surface, if present, appeared on the hanging-wall side. I do not recall having seen polished surfaces upon rocks which were high above the ground surface or upon the tops of rocks.

Later I was surprised to see the same type of polished surface on the sides of large outlying boulders, some fifteen to twenty feet in diameter, which had broken loose from the high cliffs and had tumbled out onto the surrounding apron of detrital wash. My recollection is that most of these polished areas are on the south side of the boulders and near their edges or corners. It was noted that all the patches are similar in size and position. They begin at a point about two feet off ground, often extending to a height of seven to nine feet and seldom cover a space more than five to ten feet wide, whether at the entrance to openings or on isolated boulders.

Are these polished patches remnants of once extensive surfaces of smooth rock, or are they the result of local action on limited areas such as the effects produced by desert sand-blasting, faulting or other processes? One may elaborate to no end on all the possible ways to explain such a phenomenon, but a concept that appeals to the writer and which may be of interest to the anthropologist and archeologist as well as the geologist is that these polished areas may be the "itching" or rubbing posts of prehistoric animals of the Basket Maker I or earlier time. My cursory data seem to accord with such a theory. Their height, width and position agree well with the size and habits of animals that congregate about such places for rest and shelter. The hanging-wall at the entrance to a shelter, inclined as so many of them are at an angle of about 70°, would serve as a convenient rubbing post to animals of all sizes—ground sloth, elephant, bear, antelope, etc. The footwall could hardly be made to serve such a purpose and would remain unpolished. Continual rubbing of the rocks would not only develop a polished surface but would impregnate the fine interstices of the rock with fatty oils from the skin which would wax and thus preserve these surfaces. The smooth and highly polished surfaces found on posts, pipes and other hard and resistant objects, produced by cattle in satisfying their urge to scratch, is a common sight about water holes on the Western ranges.

Another point of interest is the fact that the polished area begins about two feet above the present position of the surface of the ground. This may be

<sup>1</sup> E. Brumpt, *Compt. Rend. Acad. Sci.*, 203: 750; *idem*, *Ann. Paras. Hum. et Comp.*, 14: 597, 1936.

<sup>2</sup> E. Roubaud, J. Colas-Belcour and M. Mathis, *Bull. Soc. Path. Exot.*, 32: 28, 1939.

<sup>1</sup> Published by permission of the Director, U. S. Geological Survey.

some measure of the amount of denudation which has occurred, as marks of higher-ground levels may be seen at many places. These suggestions are offered in the light of limited observations; satisfactory answers to

the questions must await more complete inspection of all the evidence.

WALTER B. LANG

U. S. GEOLOGICAL SURVEY

## QUOTATIONS

### MR. KEPPEL'S ACHIEVEMENT

THERE are men to whom the finality of the word "retirement" does not apply, even when they relinquish a post which they have long held. They continue to be active in the world and to wield an influence, regardless of the particular title which may be given to their new work. Such a man is Mr. Frederick P. Keppel, who on November 18 next will relinquish his administrative duties at the Carnegie Corporation of New York, of which he has been president for nineteen years. He is to remain as educational adviser to the corporation.

The spending of millions of dollars—wisely—is far from an easy task, even when, as in the case of the Carnegie Corporation, the purposes for which the money may be used are clearly defined and restricted. Despite these limitations, the number of educational and other institutions clamoring for aid is enormous, as is the number of individuals in the field of education worthy of help. The task is, therefore, to weigh conflicting claims and decide where the money can be spent with the best hope of fruitful returns to society. For such a large task a man of wide interests and background, as well as of sound judgment, is needed. Mr. Keppel possesses, in addition, the capacity of saying "no" as if he were conferring a favor.

Shrewdness and hard-headedness, coupled with a gentle manner and engaging modesty, are other valuable personal weapons of Mr. Keppel. A keen observer and a good listener, he has familiarized himself with the problems of the institutions which he has been called upon to help, and he has done this with a minimum of hard feeling. This, in itself, is an achievement and bears testimony to the wisdom of

those who persuaded this man, who had been eight years dean of Columbia, and who had been Assistant Secretary of War and done important work for the Red Cross in Europe, to enter an even wider field of usefulness. Being still well under the Biblical three-score years and ten, the presumption and hope are that Mr. Keppel will continue in public or semi-public work for many happy and useful years.—*The New York Herald-Tribune*.

In November Dr. Frederick Paul Keppel will give up the presidency of the Carnegie Corporation, which he has occupied with such distinction for nineteen years. For aid from the income of that foundation innumerable applications have been made. To choose from even the most meritorious is a labor of copious knowledge and delicate judgment. Dr. Keppel has distributed that income wisely and productively. He has had the advice of experts. His annual reports have become classics.

His modesty and his gift of sympathetic cooperation had been shown in other fields. Colleges and universities, the fine arts and the sciences, research and scholarship here and abroad have been encouraged and advanced. Concrete and definite rather than general objects have been sought. Dr. Keppel has been a persuasive advocate of adult education. He has talked sense and he has written it. Those Columbians who had the good fortune to be undergraduates when he was dean of the College of Arts remember and prize him as the friend, the gay associate, the student and the former of character. He has handled many a hard job ably, and when he leaves his present post, there will still be plenty of work for him to do.—*The New York Times*.

## SCIENTIFIC BOOKS

### ELEMENTARY BIOLOGICAL TEXTS

#### LATE EDITIONS:

*Principles of Animal Biology*. By A. FRANKLIN SHULL. Fifth edition. 417 pp. New York: McGraw-Hill Book Company. 1941. \$3.50.

*Animal Biology*. By MICHAEL F. GUYER. Third edition. 723 pp. New York: Harper and Brothers. 1941. \$3.75.

*General Biology*. By JAMES WATTS MAJOR. Second

edition. 897 pp. New York: Macmillan Company. 1941. \$4.00.

*Foundations of Biology*. By LORANDE LOSS WOODRUFF. Sixth edition. 773 pp. New York: Macmillan Company. 1941. \$3.75.

#### FIRST EDITIONS:

*Human Biology*. By GEORGE ALFRED BATSELL. 621 pp. New York: McGraw-Hill Book Company. 1940. \$3.75.

*Biology and Human Affairs.* By JOHN W. RITCHIE. 1026 pp. Yonkers, N. Y.: World Book Company. 1941. \$2.32.

*This Living World.* By C. C. CLARK and R. H. HALL. 519 pp. New York: McGraw-Hill Book Company. 1940. \$3.25.

BECAUSE of the fundamental importance of the elementary course in every biological department, the available text-books are of moment to all teachers. An inspection of a series of American texts, recently issued, should therefore be comforting, for their quality is generally evident partly from the fact that many of them have reappeared in repeated editions. Such books have become well known and have been previously reviewed. It will be necessary to note therefore only recent changes that have appeared in them.

In Shull greater emphasis is given to function, and development has been reconsidered in the light of more recent knowledge. Animal relationships have been given more attention.

Guyer presents a new chapter on ecology and increases the consideration given to the experimental aspects of biological study. Much general revision of the text is found.

Mavor shows many alterations, some extending to quite extensive changes in methods of treatment. Increased emphasis is shown to physiology, neurology and ecology, and less attention is paid to distribution and to the historical aspects of the subject. Many rearrangements of material, especially that relating to plants, are evident. There have been added at the ends of chapters lists of readings and an appendix outlining the classification of plants and animals.

Considerable revision, change and rearrangement of material characterize the sixth edition of Woodruff. There are new chapters on endocrinology and on human descent, and there are many new illustrations.

It is interesting to note the degree to which these texts approximate a common method of treatment. There are variations in emphasis and in the subdivisions of topics, and Woodruff and Mavor give consideration to plant material separately, but the general topics treated do not vary greatly. The aims and methods of these authors are not significantly different. Each is obviously fully aware of the fact that something is not to be gained for nothing—that not mere information, but a way of thinking and doing is the important outcome of a course in elementary biology. Consequently, any one of these texts will serve a worthy end in a college curriculum, although local conditions or needs may, for the moment, make one preferable to the others.

Baitsell's book is not quite what the title indicates—a study of the biology of a single type, but rather, in the words of the author, "a humanizing of general

biology." The basic principles of the subject are presented in the conventional manner, but illustrations are drawn from human anatomy and physiology, and emphasis is placed on the human significance of facts and principles. Aside from the pedagogic value which attaches to the use of personally relevant material, there is an advantage, the author believes, in providing a new type of treatment for students who have already had biology presented in the usual manner. This text will have a particular appeal to those interested in biology in relation to medicine and to those whose contact with the subject is restricted to a single course. To assist in extending the interest of students there is an appendix of 92 pages wherein is found a glossary, historical notes and more extended treatments of subjects than space permits in the main text. There is, for example, a thirteen-page consideration of the subject of enzymes. Often direct quotations from important papers are given.

The book by Ritchie is definitely designed for use in high schools, although it seems somewhat mature for the purpose. It is intended to develop in the minds of students a conception of the significance of biology in human life. The method is developmental rather than informative and it does not confine itself to the use of any one of the usual procedures of types, principles or systematics. It is moreover a source book and not a fixed outline to be followed. There are "comprehension tests" at the end of each "unit" and questions for class discussion; also practical exercises, a glossary and numerous appropriate quotations from general literature. The illustrations are many and good and the typography satisfactory. Naturally in a book covering so much ground there are errors, sometimes of fact, sometimes of philosophy. On the whole, however, it should serve an excellent purpose in the hands of good teachers, but one wonders how well it will aid the teacher lacking comprehensive understanding and background.

The text by Clark and Hall is of a distinctly different type from the others in the list. Its purpose is set forth by the authors in the Preface in the following words: "The aim of this book is to present, in a form which combines accuracy with pleasant reading, the gist of modern knowledge about the living world." If one thinks comprehension and understanding or any real mental development can result from pleasantly skimming over the surface of a subject, without hard individual effort, this book would be a good one to employ.

C. E. McCLUNG

#### ACOUSTICS

*Acoustics.* By ALEXANDER WOOD, M.A., D.Sc. (Glas.) xvi+588 pp. New York: Interscience Publishers, Inc. Glasgow: Blackie and Son, Ltd. 1941. 96.00.

THIS book is characterized by a very happy mixture of experimental methods, particularly those pertaining to recent advances in acoustics, with the mathematical theory of the subject developed to the stage of use in advanced problems, but without such dilution by generalities which often, in more advanced treatises, prevents one from getting rapidly to the point which he wishes to reach.

The mathematics is presented in attractive and comparatively easily understandable form, and in the classical realm the book should form a good intermediary between an elementary book and such profound treatises as Rayleigh's "Theory of Sound."

As an illustration of the respects in which the book brings the science of acoustics up to date, we may cite from the subjects treated such topics as "Applications of Supersonic Waves," "Echo-Sounding," "Sound-ranging in Air," "Submarine Detection by Binaural Listening," "Supersonic Waves in Liquids and Solids," "Measurements of Intensity by Various Modern Methods," "Quartz Oscillators," "Magnetostriction Oscillators," a chapter containing about 40 pages on the ear and hearing, a chapter of about 30 pages on the recording and reproduction of sound and a chapter of about 30 pages on the acoustics of buildings.

The author is to be congratulated upon producing a work which should be of considerable use not only to the mathematical physicist but also to the experimental physicist who wishes to enrich the possibilities of his experiments by sound theoretical analysis.

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### THE GLASS ELECTRODE

*The Glass Electrode, Methods, Application and Theory.* By MALCOLM DOLE. xv + 332 pp. Illustrated. New York: John Wiley and Sons, Inc. 1941. \$4.50.

In 1906 Haber and Klemsiewicz first showed that the potentials on glass surfaces in aqueous solutions functioned with respect to hydrogen ion concentrations as did hydrogen electrodes. Twenty years elapsed before practical use was made of this discovery to measure pH, and it was natural that the earlier applications were made by physiologists who had long realized the importance of hydrogen ion concentration in vital processes. This delayed development was in major measure due to lack of convenient electrometers for use in the high resistance glass electrode circuits. The rapid development of thermionic tubes, which were early applied to glass electrode circuits, coincided with the rapid spread in the use of the glass electrode. To-day commercial instruments are made in large quantities by methods of mass production, and the formerly laborious pH determination with the hydro-

gen electrode is, with the glass electrode, now about as simple as a temperature measurement.

Now Professor Dole has fittingly capped this period of development and application by a treatise on the glass electrode which should be authoritative for many years to come. His knowledge, gained by much experience in the theory and practice of the glass electrode, has been combined with an unusual skill in scientific writing and the result is an authoritative book of unusual clarity and completeness.

Professor Dole devotes several chapters to theory which though brief are complete and furnish just the right amount of background for the understanding of practice. These include considerations of the theory of solutions pertinent to hydrogen ion measurements, theory of vacuum tube circuits and their application to glass electrode circuits, theory of cell assemblies and liquid junctions. In particular the chapter on the "Theory of the Glass Electrode" is noteworthy. Here the author has compiled all the literature and discussed in detail the theory and experiment which is concerned with the mechanisms by which the glass electrode functions as a hydrogen electrode.

The book devotes several chapters to the history of the development of pH methods and to special applications of the glass electrode in biological chemistry. This latter shows how varied has become the use of this new tool including as it does not only the measurement of pH of blood *in vitro* but also continuous recording of pH in circulating blood. Even instantaneous measurements of the pH changes in contracting muscle have been measured and important interpretations concerning muscle physiology drawn therefrom.

In the discussion of the application of the glass electrode in industrial research and control laboratories are included references to the important uses in food, leather, rubber and many varied industries. Special chapters are devoted to micro methods, continuous recording of pH and automatic pH control, potentiometric titrations, and many other special applications of the glass electrode. Technical details of standardization and management of glass electrode circuits are fully given in special chapters. The use and limitations of the glass electrode in non-aqueous solutions is authoritatively discussed. The extensive bibliography alone is a valuable compilation.

Research chemists, physiologists, physicists, pathologists, industrial chemists and many others will feel indebted to Professor Dole who has so ably given them this aid in their technical application of the glass electrode and a stimulus to the development of new uses for this invaluable tool.

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## SPECIAL ARTICLES

## THE SIZE OF STREPTOCOCCUS BACTERIOPHAGES AS DETERMINED BY X-RAY INACTIVATION

INFORMATION about the particle size of bacteriophages has been obtained chiefly by ultrafiltration and centrifugation methods. Data of various authors, as collected by Elford,<sup>1</sup> seem to indicate that the particles of each phage are homogeneous in size; and that particle size is a characteristic property of each phage. Coli-dysentery phages have particles ranging from 8-20  $\mu$  (phage "S13") to 50-75  $\mu$  diameter (phage "C16"). Staphylococcus phage "K" has a diameter of about 50-70  $\mu$ . The largest phage at present known has particles of 80-120  $\mu$  (Subtilis phage).

While the particle size values as given above are usually accepted, it must be mentioned that diffusion studies<sup>2</sup> have suggested that phage particles may be much smaller and inhomogeneous in size.

A new method has recently been developed,<sup>3</sup> which, on the basis of radiation experiments, seems to give useful information about the particle size of bacteriophages.

When suspended in a suitable medium the sensitivity to x-rays of a phage strain, measured by the percentage of active phage which remains after a certain amount of radiation has been given, is a highly reproducible property of that strain, and appears to be a function only of the size of its particles. The irradiation experiments interpreted in terms of the "hit theory" indicate that a phage particle is inactivated by a single ionization (or excitation) process. In order to be effective this process must take place within a "sensitive volume," the size of which can be calculated from the rate of inactivation. This volume is found for each strain of phage to be of the same order of magnitude as the volume of the phage particle itself, as determined by ultrafiltration and centrifugation.

We have now used this method to obtain information about the particle sizes of three streptococcus bacteriophages, which had not previously been measured. These phages have been described by A. C. Evans.<sup>4</sup> They are distinguished by their serological specificity, by bacterial host specificity and by the type of plaque they produce on solid medium.

Samples of the bacteriophages suspended in peptone

<sup>1</sup> W. J. Elford, in Doerr and Hallauer, *Handbuch d. Virusforschung*, p. 126, Julius Springer, Wien, 1938.

<sup>2</sup> J. Bronfenbrenner, *Jour. Exp. Med.*, 45: 873, 1927; D. M. Hetler and J. Bronfenbrenner, *Jour. Gen. Physiol.*, 14: 547, 1931; J. H. Northrop, *Jour. Gen. Physiol.*, 21: 335, 1933.

<sup>3</sup> E. Wollman, F. Holweck and S. Luria, *Nature*, 145: 935, 1940; D. E. Lea, *Nature*, 146: 137, 1940.

<sup>4</sup> A. C. Evans, U. S. Public Health Reports 49: 1386, 1934.

broth in small celluloid tubes were exposed to x-rays (475 kv equivalent constant potential, 13 ma, .25 mm Cu plus .45 mm Al filter, 960 roentgens/min. measured in air at 37 cm focal distance, absorption and scattering corrections negligible). Afterward the phage content of each sample was determined by plaque count. The results are shown in Fig. 1.

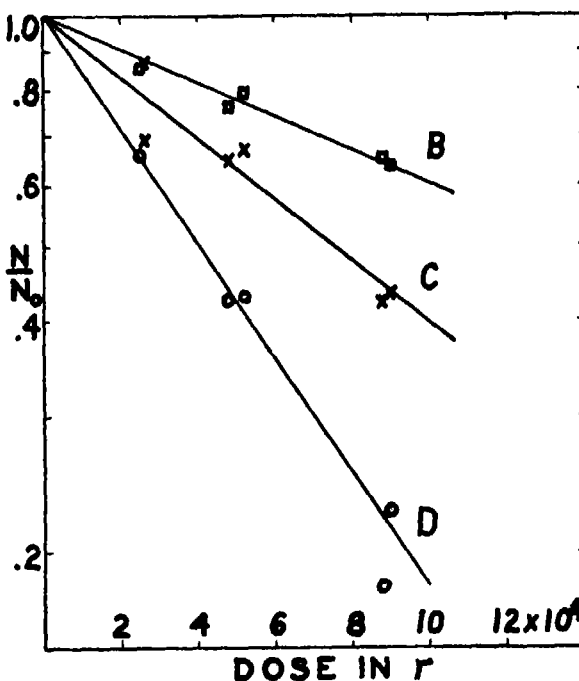


FIG. 1. Inactivation curves for three streptococcus bacteriophages. Abscissas: dose of x-rays in roentgens. Ordinates: proportion of bacteriophage particles remaining active after irradiation.

It is evident that in each case the experimental points can be fitted by an exponential curve (straight line on semi-logarithmic plot) within the limits of the experimental errors, which in plaque counts with streptococcus phages are likely to be rather large. Having established the exponential relation with great precision for other phages,<sup>5</sup> we shall assume it to apply here.

Table I gives the diameters of the "sensitive volumes," calculated from the curves in Fig. 1 by Lea's method.<sup>5</sup> Assuming that the relationship which exists for other phages between size of sensitive volume and particle size is also valid for the streptococcus phages we can tentatively consider the values of Table I as estimates of particle size. It should be mentioned that the recognized uncertainties in the absolute measurement of x-ray dosage at 500 kv are not large enough

<sup>5</sup> S. E. Luria and F. M. Exner, *Proc. Nat. Acad. Sci.*, 27: 370, 1941.

TABLE I

Bacteriophage	Streptococcus strain	Inactivation dose in r*	Sensitive volume diameter $\mu\mu$
B .....	563	200,000	26
C .....	594	110,000	33
D .....	693	60,000	43

\* Dose giving inactivation ratio  $\frac{N}{N_0} = 1/e$ .

to influence the present results, since particle diameters depend (through volumes) on cube roots of inactivation rates.

A comparison with previously measured phages<sup>5</sup> shows that phage D is a medium size phage; phage C falls among small phages (like C13 Burnet); and phage B is still smaller.

The classification of these three phages as separate entities, based up to now on their different biological properties,<sup>4</sup> finds further justification in their different particle sizes.

A general relationship of inverse proportionality has been shown to exist between the size of phage particles and the size of the plaques they produce on agar (Elford, Burnet). Such comparisons are definite only for plaques produced in presence of the same host strain of bacteria, which was not the case in our experiments. Nevertheless, it is probably not meaningless that the smallest phage B is a "large plaque forming" strain, whereas the larger phage D produces very small plaques.

We hope soon to check the particle size values as given here by other methods (ultra-centrifugation, electron microscope).

We are indebted to Dr. A. C. Evans for supplying the strains of bacteriophages and of host bacteria. Only three out of four strains were studied, owing to difficulty in obtaining reproducible counts of the plaques formed by phage A.

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### THE DETECTION OF POLIOMYELITIS VIRUS IN FLIES<sup>1</sup>

THE present note describes two instances in which the virus of poliomyelitis has been detected in collections of flies made in the field during epidemics of this disease. The first positive test was obtained from a summer camp (Camp S.) in Connecticut, where at least three frank cases of poliomyelitis occurred dur-

ing the latter half of July, 1941, among a varying population of about 100 children, and where during the first half of August, two other proven, convalescent (intestinal) carriers were present among the campers. A sample of roughly 1,000-1,200 flies, caught out of doors in the vicinity of the camp kitchen on August 6th and 8th, was stored in the refrigerator until ready for inoculation. The bulk of this sample was made up of several varieties, including in particular, three types of green-bottle flies or *Lucilia* (viz.: *sericata*, *caesar* and *sylvorum*) and one variety of blow-fly, *Phormia regina*. In lesser numbers there were also representatives of the common house fly (*Musca domestica*) and flies of the following species: *Muscina stabulans*, *Sarcophaga haemorrhoidalis*, *Ophyra leucostoma*, *Protocalliphora*, and some questionable examples of *Stomoxys*.<sup>2</sup>

Two types of inocula were prepared: (a) an emulsion of 100-300 flies macerated in 200 cc of sterile water; and (b) washings from 400-600 flies in 50 cc of water. Sample *a* was centrifuged and from the mid-layer a 30 cc portion was frozen and set aside for nasal instillation, while to another 20 cc mid-layer portion, 15 per cent. ether was added (for bactericidal purposes) and it was allowed to stand in the ice box overnight before being injected intraperitoneally. Sample *b* was filtered through gauze and used for nasal instillation. On August 12th, 10 cc of the etherized portion of sample *a* was injected intraperitoneally, and on 3 successive days 2 cc amounts of samples *a* and *b* were instilled intranasally into one cynomolgous monkey (No. 1676). This animal developed poliomyelitis after an incubation period of 15 days.

The second specimen of flies to yield the virus was obtained in the vicinity of Jasper, Alabama, where poliomyelitis was epidemic during July and August, 1941. On August 20th, a fly trap was placed near a privy used by three households where cases of poliomyelitis had recently occurred. On August 24th, a sample of flies, representing about 200 specimens (unidentified as to species, except for the presence of green-bottle flies, blow-flies and probably house flies) were removed from the trap, packed in dry ice and mailed to New Haven, where they were prepared and inoculated into one cynomolgous monkey (No. 1840) which developed poliomyelitis after an incubation period of 9 days. The methods used were essentially the same as those described in the first animal.

Criteria for the identification of the virus in these two instances have been that the monkey developed signs and symptoms of the experimental disease; that typical histological lesions were found in the cervical

<sup>1</sup> Aided by a grant from the National Foundation for Infantile Paralysis, Inc.

<sup>2</sup> We are indebted to Dr. R. B. Friend, of the Connecticut Agricultural Experiment Station of New Haven, for the identification of the specimens.

and lumbar levels of the spinal cord. Both strains of virus have been passed in other monkeys, and 6 mice inoculated intracerebrally with each strain have remained well.

During the summer of 1941 four other samples of flies from epidemic areas have been tested in eight cynomolgous and green African monkeys in our New Haven Laboratory with negative results. Previously we had also tested by various methods many samples of flies and many varieties of other insects collected from seven epidemics over a period of ten years. In the majority of these earlier tests rhesus monkeys were used; all these tests proved negative.

It is well known that house flies contaminated artificially will harbor or carry the virus of poliomyelitis for several days.<sup>3</sup> Furthermore, occasional attempts at transmission of the experimental disease through the agency of the stable fly (*Stomoxys calcitrans*) seem to have been successful.<sup>4</sup> To our knowledge, however, the only other report which might be construed as an example of a positive test from flies in nature, is that of Rosenow, *et al.*<sup>5</sup> In one of their monkeys (variety unspecified) inoculated with a filtrate of flies collected during the epidemic of poliomyelitis in Kentucky in 1935, poliomyelitis apparently developed.

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### THE LOCALIZATION OF THE NICOTINE SYNTHETIC MECHANISM IN THE TOBACCO PLANT

EVIDENCE is to be presented elsewhere<sup>1</sup> that tobacco shoots grown as scions upon tomato roots contain only traces of nicotine and that tomato shoots grown as scions upon tobacco roots accumulate large quantities of the alkaloid. Analogous experiments have just been

completed in which reciprocal grafts of *Datura Stramonium* L. and *Nicotiana tabacum* L. var. Turkish have been examined for their nicotine content. Essentially the same results have been obtained as have been reported for the tobacco and tomato graft hybrids. After approximately one month of growth the *Datura* scions had accumulated 10 mgms of the alkaloid each, which represents a concentration of 0.03 per cent. on the basis of fresh weight. The leaves of each tobacco scion contained on the average only 4.5 mgms of nicotine, a quantity which was not significantly greater than the amount present in the scion at the time of preparation of the graft. Increase in fresh weight during the thirty-day period of growth was 44-fold for the tobacco and 10-fold for the *Datura* scions. Since the above data obviously suggest the possibility that nicotine may be manufactured in the root system of the tobacco plant and not in the leaves, as has been believed heretofore, a number of experiments have been performed which contribute indirect evidence in support of such an interpretation.

A number of Turkish tobacco leaves were cut from the stalks and rooted in moist sand. In the beginning each leaf contained 0.96 mgm of nicotine, but after development for about two months the alkaloid content increased to 46 mgms per leaf. At the end of another 16 days this figure had again increased to 71.6 milligrams. The root system attached to each leaf of the last two collections contained 2.4 mgms and 2.7 mgms, respectively. In view of the constantly increasing amount of nicotine in the leaves, the relative constancy of the amount present in the root system appears to substantiate the idea that the seat of nicotine synthesis is the root and that the presence of the alkaloid in the leaf tissues may best be explained on the basis of translocation and accumulation.

If the presence of nicotine in tobacco leaves is to be regarded as a result of translocation from the roots and not as a synthesis *in situ*, then it should be possible to detect the alkaloid in appreciable amounts in either the xylem or the phloem of the tobacco stalk. Consequently, the stalks of four mature, field-grown Turkish tobacco plants were separated into three fractions which consisted almost entirely of (1) xylem, (2) pith and (3) phloem, pericycle, cortex and epidermis. The separation was easily effected, since the secondary xylem of the stalk forms a hard woody cylinder from which the more succulent tissues are readily peeled. The results of the analyses of these fractions are given in Table I. It is readily observed that nicotine was present in the xylem in sufficient amount to establish this tissue as a possible path for the movement of the alkaloid from root to leaf. In substantiation of this observation, the cut stumps of six Connecticut Broad-leaf No. 38 tobacco plants were allowed to bleed into

<sup>3</sup> S. Flexner and P. F. Clark, *Jour. Am. Med. Assn.*, 56: 1717, 1911; C. W. Howard and P. F. Clark, *Jour. Exp. Med.*, 16: 850, 1912.

<sup>4</sup> M. J. Rosenau and C. T. Brues, *Trans. XV Internat. Cong. Hyg. and Demog.*, Washington, 1912, 1: 616, 1918; J. F. Anderson and W. H. Frost, *U. S. Pub. Health Rept.*, 27: 1733, 1912.

<sup>5</sup> E. C. Rosenow, L. H. South and A. T. McCormack, *Kentucky Med. Jour.*, 35: 437, 1937.

<sup>6</sup> National Research Council Fellow.

<sup>1</sup> R. F. Dawson, in press.

TABLE I  
THE DISTRIBUTION OF DRY WEIGHT AND OF NICOTINE IN  
TOBACCO STALKS

Tissue fraction	Dry weight per stalk gm.	Nicotine per stalk mgm	Per cent. of total nicotine in one stalk
Xylem .....	14.3	2.8	19.2
Pith .....	3.8	4.7	32.2
Cortical tissues	4.5	7.1	48.6

porcelain evaporating dishes, and the sap thus obtained was analyzed for nicotine. The results show that this material, which, incidentally, could be seen to exude from the xylem only, contained 0.24 mgm of nicotine per milliliter. The possibility is not to be excluded that the translocation of nicotine, if it

actually occurs, may take place, in part at least, in the phloem. From the evidence at hand, however, the following tentative suggestions are advanced: (1) nicotine is apparently synthesized in appreciable amounts only in the roots of the tobacco plant; (2) the presence of the alkaloid in the leaves of the intact plant in higher concentrations than exist in either stalks or roots may be explainable on the basis of translocation and accumulation; and (3) the presence of the alkaloid in appreciable amounts in the xylem suggests that nicotine may move from root to leaf principally through this component of the vascular system.

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## SCIENTIFIC APPARATUS AND LABORATORY METHODS

### A NEW TYPE OF MICRO-RESPIROMETER

THIS apparatus functions as a constant pressure volumeter, which is a type not hitherto described. It consists simply of a fine bore capillary tube with a mercury piston at one end, a stopcock at the other end and, near the middle, a T-connected conical tube that has a pocket for alkali and supports a coverglass on which the experimental material is placed as a hanging drop. An index drop (high boiling kerosene), placed between T-joint and stopcock, divides the gas space into an experimental volume ( $V_e$ ) and a control volume ( $V_c$ ).  $V_e$  is maintained constant by returning

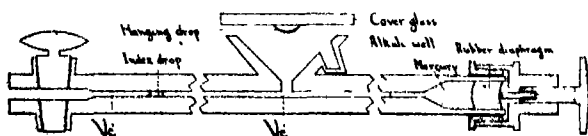


FIG. 1. Diagram of micro-respirometer. Alkali well is at right angles to position in diagram. A T-connection for introducing mercury is not shown. Overall length, 17 inches.

the index drop, at each reading, to its original position by means of the mercury piston. The distance that the mercury moves, multiplied by the cross-sectional area of the capillary, gives directly the volume of gas absorbed or produced. The respirometer is immersed in a water bath and readings are taken through microscopes with eyepiece micrometers. Some of the principal features of the apparatus are: (1) Construction is simple and inexpensive. (2) The readings are not affected by temperature change, since according to the gas laws a change from  $T$  to  $fT$  in the system is accompanied by a proportionate change in pressure to  $fP$ . Thus, if the absorption or production of  $x$  moles of gas gives a volume change,  $\Delta V$ , at  $T$  and  $P$ , it will be  $\frac{f}{T} \Delta V$  at  $fT$  and  $fP$ . In other words, the

temperature may vary by any amount and displacements of the mercury meniscus will still measure the same amounts of gas change as at the temperature and pressure of the initial reading. Temperature control is therefore unnecessary, except to the extent that it is desirable to avoid large variations in the rate of metabolism of the tissues. It is, however, essential to avoid temperature differences between the two gas spaces. (3) By setting the drop in motion before each reading the mercury piston insures attainment of pressure equilibrium. It also simplifies the initial setting of the drop and wetting of the capillary. (4) Fluid and gas volumes need not be known. (5) Cells can be observed during the experiment. (6) Material can be added from an adjacent drop by tapping or tipping or the incorporation of a small piece of iron filing and the use of a magnet. (7) Since the cells lie on the bottom of the hanging drop, gas exchange is facilitated without the necessity of shaking the apparatus.

Using capillaries of 0.2 mm diameter and reading to the nearest 0.005 mm, a volume change of 0.003 cu mm (0.1 mm displacement) is measurable with a reading error of 10 percent. There is, however, a factor that has prevented the attainment of this sensitivity; namely, that the index drop drifts when the respirometer is empty. The drift is variable and has ranged in different tests from 0.05 to 0.2 mm per hour. It is always in the direction of  $V_e$ . Tests under various conditions have eliminated, as possible causes, such factors as non-uniform temperature change, leaks, gravity, non-uniformity of capillary bore, osmotic pressure of solutions, etc. Dr. Needham<sup>1</sup> suggested that it may be due to a slow oxidation of the petrolatum used for sealing on the coverglass, but other greases have not as yet eliminated the drift. In each

<sup>1</sup> Personal communication.

run it is fairly constant, so some correction for it may be made by taking blank readings. With sufficient quantities of material the drift is negligible. Five experiments with samples of 1,000 to 2,000 fertilized *Strongylocentrotus* eggs gave oxygen consumption values of  $6.6$  to  $7.1 \times 10^{-5}$  cu mm/hour/egg as compared with an average of  $6.4 \times 10^{-5}$  from Warburg manometer measurements on about 100,000 eggs. Four experiments on samples of 100 to 200 eggs gave, when corrected for the drift, values of  $5.3$  to  $9.1 \times 10^{-5}$ . While this variation would be greatly diminished by elimination of the drift, the apparatus is still usable with reasonably small amounts of material. It should be noted, too, that it offers advantages over other types of respirometers on a macro-scale as well.

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### A QUALITATIVE TEST FOR BILE IN THE URINE

DURING the course of an investigation involving frequent determinations of sulfonamide drugs in urine by the Maher-Camp modification of the Marshall method,<sup>1</sup> several samples of urine were obtained which developed a marked green color upon the addition of the sodium nitrite reagent used in the determination. Subsequent investigation indicated that bile, present in these urines, was responsible for the green color, and led to the following qualitative test for the presence of bile in urine:

Ten cc of suspected urine are placed in a test-tube and acidified by the addition of 1 cc of a 20 per cent. solution of para-toluenesulfonic acid. Ten per cent. hydrochloric acid may also be used, although better results have in our hands followed the use of the organic acid. Two minutes later, 1 cc of a 0.1 per cent. freshly prepared solution of sodium nitrite is added, and the contents of the tube are mixed well. The development of a green color indicates the presence of bile, presumably by the oxidation of bilirubin to a green derivative. So far, we have found no substances which produce a similar reaction.

Further studies have indicated a marked difference in the reaction of various types of bile to this test. We have been able to detect the presence of dog bile (gall-bladder) in aqueous dilutions of as high as 1:1,000, and the presence of this concentration of dog bile diluted in normal human urine can be demonstrated by this test. However, rabbit bile (gall-bladder) is usually not demonstrable in aqueous dilutions greater than 1:50 to 1:100. Human biles have varied rather widely, with the sensitivity in aqueous dilution ranging from 1:60 to 1:500.

<sup>1</sup> F. T. Maher and W. J. R. Camp, *Jour. Lab. and Clin. Med.*, 24: 1198, 1939.

In three samples of pathological urines, obtained from jaundiced subjects, the sensitivity and convenience of the above method were compared with results obtainable by the usual Gmelin and Huppert techniques. Using these three urine specimens, little difference in sensitivity could be demonstrated—in each case positive tests for bile were demonstrable in aqueous dilutions of 1:50 to 1:60, and results were unconvincing in higher dilution. However, the nitrous acid oxidation method was more rapid and convenient of application, avoided the use of the nitric acid or the shaking out with calcium hydroxide, and afforded results comparable with the best results obtainable with the Gmelin or Huppert techniques. Results are more easily read than those by Gmelin's test, due to the diffusion of the green color and the avoidance of the ring formation.

Attempts to establish a quantitative analysis based upon the above procedure have not been successful due to the difficulty in preparing a stable and utilizable solution of bilirubin.

Obviously, the presence of bile in the urine of jaundiced subjects may interfere with the determination of sulfonamide drugs in such samples.

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## CULTIVATION OF RICKETTSIAE OF THE ROCKY MOUNTAIN SPOTTED FEVER, TYPHUS AND Q FEVER GROUPS IN THE EMBRYONIC TISSUES OF DEVELOPING CHICKS<sup>1</sup>

By Dr. HERALD R. COX

THE ROCKY MOUNTAIN LABORATORY, THE NATIONAL INSTITUTE OF HEALTH, HAMILTON, MONT.

I AM deeply conscious of the honor which the American Association for the Advancement of Science has conferred in selecting me as the recipient of the Theobald Smith award.

I take this opportunity to express my appreciation

<sup>1</sup>Contribution from the Rocky Mountain Laboratory (Hamilton, Montana) of the Division of Infectious Diseases of the National Institute of Health. Address delivered on September 22, 1941, to the Section on Medical Sciences upon receipt of the Theobald Smith Award of the American Association for the Advancement of Science.

to my former chief, Dr. Peter K. Olitsky, of the Rockefeller Institute, for his continued and neverfailing interest in my work, to Drs. R. R. Parker, director of the Rocky Mountain Laboratory, and R. E. Dyer, chief of the Division of Infectious Diseases, The National Institute of Health, for their sympathetic understanding and cooperation in making these studies possible, and to my assistants, E. John Bell and Lyn-dahl E. Hughes, for their loyal and invaluable aid.

In 1938 the author reported: First, a simple tech-

nique by which the rickettsiae of the Rocky Mountain spotted fever and typhus groups can be cultivated abundantly in the yolk sac of the developing chick embryo; and secondly, that suspensions of yolk sacs infected with spotted fever or typhus rickettsiae are from 100 to 1,000 times more infective than other tissues of the developing chick embryo or mammalian tissues.<sup>2</sup> Later it was shown that yolk sac cultures were highly suitable for the production of consistently good immunizing vaccines for Rocky Mountain spotted fever, European and endemic typhus and American "Q" fever.<sup>3, 4, 5, 6, 7</sup> In the following pages the present method for initiating and maintaining passage strains in eggs will be described and the results of the use of the yolk sac technique for cultivating rickettsiae and preparing rickettsial vaccines brought up to date.

#### METHOD OF INOCULATING EGGS AND MAINTAINING STRAINS

Briefly, this is as follows: Fertile eggs incubated for 6 to 7 days at 39° C. are injected in the yolk with infectious material by means of a hypodermic syringe and a 20-gauge needle, 1 to 1½ inches long. The inoculum, consisting of 0.5 to 1.0 cc of infected, defibrinated guinea pig blood, testicle washings, spleen or brain is introduced through a needle-sized opening in the air-sac end of the egg. After sealing the hole with paraffin, the inoculated egg is incubated at 32° C. in the case of spotted fever, or at 37° C. for typhus or the other rickettsial infections discussed in this paper. Upon death of the embryo, which usually occurs in 3 to 5 days, depending upon the species of rickettsia used, transfer to other fertile eggs is made by means of 0.5 cc of a 5 to 10 per cent. suspension of yolk sac in a 50-50 mixture of sterile beef infusion broth and saline or by using a like quantity of undiluted yolk fluid. Passage strains can be maintained by either method. Yolk fluid is satisfactory for maintaining strains, but when the tissues are to be used for vaccine production, yolk sac suspension is the preferred inoculum because of its markedly greater infectiveness.

Rickettsiae of the following diseases have thus far been cultivated and studied by means of the above-described technique: Rocky Mountain spotted fever (a western Montana, *Dermacentor andersoni* strain and an Iowa, *Dermacentor variabilis* strain), endemic typhus (Wilmington strain), epidemic or European typhus (Breinl strain), boutonneuse fever (a Moroc-

can strain), Brazilian spotted fever (São Paulo and Minas Geraes strains), Tobia petechial fever of Colombia, *maculatum* infection (from *Amblyomma maculatum* collected in Texas and Georgia), Australian and American "Q" fever, and South African tick-bite fever.

This method has also been used by others for cultivating rickettsial agents, viruses, bacteria and spirochetes.

When establishing strains in eggs there is a period of adaptation before optimal growth occurs. In the first few passages the embryo does not die for a relatively long period, and maximum multiplication of rickettsiae is usually not achieved before 4 to 6 passages. Strains once established can apparently be maintained indefinitely. As a matter of fact, we have had to rely upon the egg method for the uninterrupted maintenance of certain rickettsial strains such as boutonneuse fever, "maculatum" infection and *variabilis* strains of spotted fever. At Hamilton these can be maintained in guinea pigs either not at all or only with the greatest difficulty.

Guinea pigs inoculated with recently established yolk sac strains of the various rickettsioses studied exhibit the following differences when compared with animals receiving guinea pig passage strains: The incubation is usually shortened to 24 to 48 hours; the fever is higher and the febrile period more prolonged; endemic typhus, European typhus, "maculatum" infection and *D. variabilis* spotted fever infections are sometimes fatal; erythema and swelling of the scrotum is frequent in animals infected with European typhus and *variabilis* spotted fever and is intensified in those ill with boutonneuse fever, endemic typhus, "maculatum" infection and the highly fatal type of spotted fever and its South American relatives; scrotal necrosis and sloughing is often more extensive in those infections in which it commonly occurs and may occasionally be seen in diseases in which otherwise it never appears; and finally, in titrations of highly virulent strains of spotted fever even the end-point infective dilution causes fatal infection and death. However, this quality of increased virulence for guinea pigs does not persist with further guinea pig passage. Instead, the usual strain characteristics are generally regained within 3 or 4 transfers.

After strains are carried through a number of yolk sac passages a rather constant killing time for the embryo is established. Guinea pigs inoculated with concentrated yolk sac suspensions of the later egg passages may still show a shortened incubation period, yet the severity of the course of infection is noticeably lessened, as a rule, and in quantitative tests animals that receive the higher dilutions often suffer only inapparent, immunizing infections. This has been found

<sup>2</sup> Herald R. Cox, *Pub. Health Rep.*, 53: 2241, 1938.

<sup>3</sup> *Ibid.*, *Pub. Health Rep.*, 54: 1070, 1939.

<sup>4</sup> Herald R. Cox and E. John Bell, *Pub. Health Rep.*, 55: 110, 1940.

<sup>5</sup> Herald R. Cox, "Cultivation of Rickettsiae in the Embryonic Tissues of Developing Chicks." Presented before the Sixth Pacific Science Congress, July 29, 1939.

<sup>6</sup> Herald R. Cox and E. John Bell, *Pub. Health Rep.*, 54: 2170, December 8, 1939.

<sup>7</sup> Herald R. Cox, *Am. Jour. Trop. Med.*, 20: 463, 1940.

true for all the rickettsial strains studied, but particularly so for those of American and Australian "Q" fever and the *Dermacentor variabilis* strain of spotted fever.

*The features that make the yolk sac technique of particular value are its extreme simplicity and the ease with which cultures may be maintained with a minimal risk of contamination.* During the past year we have used approximately 30 dozen eggs daily and have found contaminants in less than 1 egg in 2,500.

#### PREPARATION AND POTENCY TESTING OF VACCINES

Experience has suggested that it is best to use only organisms of maximum virulence in the preparation of killed vaccines. Therefore, our present practice is to use for this purpose only strains that have been carried through a limited number of egg passages. Rocky Mountain spotted fever and typhus strains employed for vaccine manufacture are alternated between a series of 40 to 50 yolk sac passages and several transfers through guinea pigs. Nevertheless, we have produced good vaccines against spotted fever and European typhus with materials from eggs of the 246th and 90th passages, respectively.

Vaccines have been prepared by a variety of methods, too numerous to mention. Several have given good results consistently. We will describe only the one that has been employed in making the bulk of the Rocky Mountain spotted fever and epidemic typhus vaccines used for field trials. While the pooled embryonic tissues were used (yolk sac, chorio-allantois and embryo) for these vaccines, we have ample evidence that much richer vaccines in proportion to residual protein may be prepared from only the yolk sac and chorio-allantois or from yolk sac alone. *Again I wish to emphasize that good vaccines can not be obtained consistently without using the yolk sac.*

Upon death of the embryos (in spotted fever this occurs 2 to 3 days, in typhus 4 to 5 days, after inoculation) the pooled embryonic tissues are harvested from all eggs of the same transfer. These are weighed and homogenized to a 12½ per cent. suspension in saline containing 0.5 per cent. phenol and 0.3 per cent. formalin.<sup>8</sup> This suspension is centrifuged at 5,000 r.p.m. for 50 to 60 minutes and the supernatant fluid, which contains the great bulk of lipoids and some soluble proteins, is poured off. The sediment is resuspended with aid of the homogenizer in a volume of saline equal to the original weight of the pooled tissues. Phenol and formalin are added to give a final concentration of 2.0 per cent. and 0.3 per cent., respectively. The resuspended material is placed at

room temperature for 6 to 7 days and shaken vigorously daily. During this interval the great bulk of protein is precipitated by the phenol. The suspension is then diluted with 5 volumes of sterile saline and stored at 36° F. for 7 or more days. It is finally centrifuged at 2,500 to 3,000 r.p.m. for 20 minutes, and the resulting supernatant fluid constitutes the vaccine.

The method of preparation described does not give as great a yield as the one previously reported, but does produce a more potent vaccine with less residual extraneous protein. It is highly practical from the standpoint of cost, ease of manipulation and quantity production. Approximately one liter of vaccine can be prepared from 20 eggs. A bacteriologist and two assistants, provided with proper facilities, can readily prepare from 40 to 50 liters of vaccine per week. At Hamilton we have found it feasible to prepare these vaccines in lots of 25 to 35 liters each.

#### POTENCY TESTS

Seven guinea pigs are used for testing the potency of each lot of spotted fever vaccine. Each animal receives two ½ cc injections of vaccine subcutaneously 5 to 7 days apart. Fourteen days later each is tested for immunity by injecting intraperitoneally 1 cc of citrated blood taken from infected guinea pigs on the third or fourth day of fever. A suitable number of control guinea pigs receive the same inoculum. Highly virulent strains that kill 80 per cent. or more of the control animals are always used, and repeated tests have shown that 1 cc of such infected blood contains from 100 to 1,000 infectious doses for guinea pigs. Temperatures are taken daily for 10 days, and animals that show temperatures of 39.8° C. or higher for 2 or more consecutive days are considered as having spotted fever unless it is quite obvious that some intercurrent infection is present. Five of the 7 test guinea pigs must show complete protection before the lot of vaccine is considered usable.

Typhus vaccine is tested in much the same manner. Twelve guinea pigs are used for the potency test, and each receives two 1 cc injections of vaccine. The test dose for immunity consists of 1 cc of a lightly centrifuged (1,500 r.p.m. for 10 minutes in an International Size 2, horizontal head centrifuge) 5 per cent. suspension of infected brain tissue taken from guinea pigs on the fourth or fifth day of fever. Repeated tests have shown that this inoculum contains 100 to 1,000 infectious doses. Temperatures are taken for 18 days, and 9 of the 12 vaccinated guinea pigs must show complete protection before the vaccine lot is issued.

Quantitative tests carried out recently with vaccines prepared as described above revealed that guinea pigs can be completely protected against the standard test

<sup>8</sup> We have found the Waring-Blendor unit (manufactured by the Waring Corporation, New York City) to be an invaluable aid for homogenizing large amounts of tissue in minimum time. A 51° angle centrifuge was used in all experiments.

dose of spotted fever blood virus by giving them as little as 1/16 cc of vaccine on two occasions. In other experiments it was found that the standard dose of vaccine used in the spotted fever and typhus tests protected guinea pigs in each instance against 100,000 to 1,000,000 infectious units of yolk sac virus. These results certainly indicate a high degree of protection. However, as previously stated, still more potent vaccines can readily be prepared by simply increasing the relative concentration of yolk sac tissue in the final product.

#### ANTIGENICITY OF CHICK EMBRYONIC TISSUES

I wish to emphasize that we early recognized the serious problems involving sensitization that might arise through the use of such a vaccine. Animal experiments along these lines can be summarized by stating that guinea pigs injected with amounts of vaccine varying from 0.1 to 1.0 cc proved to be entirely unaffected by a shocking dose of 1 cc of the same material given intracardially 20 to 40 days later. These results suggest that any serious sensitization problem is unlikely.

Data collected in vaccinating the personnel of the Rocky Mountain Laboratory and the results of rather extensive field trials carried out this past year appear to support this premise. The laboratory group receiving chick vaccine consisted of 170 persons, including families of the workers. The number of vaccinations and amounts given ranged from a single injection of ½ cc to 14 doses of 1 cc each. In these tests monovalent spotted fever and typhus vaccines, as well as a bivalent vaccine (spotted fever and epidemic typhus) and a trivalent vaccine (spotted fever, epidemic typhus and American "Q" fever) were used. None of the vaccinated individuals reported any reaction other than a slight local tenderness at the site of inoculation, which always disappeared within a day or so.

In addition, more than 226 liters of typhus vaccine, enough for approximately 75,000 people, and more than 200 liters of spotted fever vaccine, enough for approximately 50,000 people, were used in field trials this past year.

The typhus vaccine was sent to Hungary, Rumania, Spain and China; the greatest amounts to the last two countries. Unfortunately, because of the upset conditions due to the war, the results of these trials have either been inconclusive or have failed to reach us. At the present time an attempt is being made to obtain a thorough test of the typhus vaccine in Bolivia. Drs. R. E. Dyer and N. H. Topping, of the National Institute of Health, are now in Bolivia for this purpose.

Physicians to whom the spotted fever vaccine was sent were requested to make careful observations of

all people vaccinated and to immediately notify us of any consequential reaction or the occurrence of a spotted fever infection. No serious reaction has been reported. In fact, the evidence suggests that this vaccine is more readily tolerated than the tick type, and that it can be used for patients who have had to discontinue taking the latter. One report to the contrary was received. Noteworthy is the fact that there were no reactions in a number of persons known to be allergic to egg protein.

One case of spotted fever was reported in a vaccinated individual. The attending physician informed us that the patient, a man 53 years old, showed a typical rash. However, he was only mildly ill for less than 2 weeks; was not hospitalized, and continued to work some each day.

It is too early to attempt to draw any conclusions concerning the immunizing value of these vaccines in man, but the results to date are encouraging.

#### OTHER RICKETTSIAL VACCINES

We have used essentially the same method to prepare vaccines against endemic typhus, American "Q" fever, boutonneuse fever and Tobia fever. This last-named disease apparently is a highly virulent form of spotted fever that occurs in limited areas in Colombia, South America. Spotted fever vaccine prepared from highly virulent western Montana strains confers complete protection against Tobia fever, and Tobia fever vaccine similarly confers complete protection against western Montana strains. We recently sent Tobia fever vaccine to Dr. Luis Patiño-Camargo, director of the Federico Lleras Institute, Bogotá, Colombia, who reported that it afforded complete protection to guinea pigs against his strains of Tobia fever. We are now supplying Dr. Patiño with sufficient quantities of vaccine to take care of the needs in the several endemic foci.

#### PREPARATION OF RICKETTSIAL SUSPENSIONS FOR AGGLUTINATION AND DIAGNOSTIC SKIN TESTS

The abundant growth of the various strains of rickettsiae in the yolk sac has made it possible to prepare, by fractional centrifugation methods, practically pure suspensions of rickettsiae suitable for agglutination tests. Formalinized suspensions of American and Australian "Q" fever and European typhus rickettsiae have been prepared and are quite stable in storage and quite agglutinable by specific antisera. For over a year we have routinely run agglutination tests for American "Q" fever on all sera sent in for Weil-Felix, *B. tularensis* or *B. abortus* tests.

More recently we have prepared partially purified suspensions of Rocky Mountain spotted fever rickettsiae, and studies are now in progress to determine if

these, as well as similar suspensions of European and endemic typhus and American "Q" fever rickettsiae, can be used for diagnostic skin tests.

The method of thus preparing practically pure suspensions of rickettsiae by relatively simple procedures opens up many additional possibilities of study along immunological, serological and chemical lines.

OBSERVATIONS RELATIVE TO A *Dermacentor variabilis*  
STRAIN OF ROCKY MOUNTAIN SPOTTED FEVER  
MODIFIED DURING YOLK SAC PASSAGE

In conclusion I would like to report observations relative to a *Dermacentor variabilis* strain of spotted fever that has been maintained in eggs for 240 serial transfers since April, 1938. This strain was originally isolated in guinea pigs by inoculating them with a suspension of tissues from *Dermacentor variabilis* ticks collected in Iowa. Several transfers with spleen tissue were successfully made in guinea pigs, but the infection was very mild and a number of animals showed only inapparent infections or failed to react. The strain in guinea pigs was finally lost, but fortunately had already been established in eggs. Tests carried out with yolk sac suspensions of the eleventh and fifteenth egg passages revealed that a marked change, characterized by much greater virulence for guinea pigs, had taken place. Thirty-six guinea pigs were inoculated intraperitoneally with 1 cc each of a 10 per cent. yolk sac suspension. All had high fevers, prolonged temperature curves, erythema and swelling of the scrotum. Of 19 that showed scrotal necrosis and sloughing, 10 died. Titration tests of this same suspension resulted in frank infections, typical of spotted fever in dilutions up to and including one to a million. No inapparent immunizing infections occurred in those animals inoculated with higher dilutions. This enhanced virulence was maintained through about 50 passages. Tests made at random between the fiftieth and one hundred and twenty-fifth

egg passages revealed the yolk sac suspensions were becoming markedly less virulent and that a great number of inapparent, immunizing infections were being induced in inoculated guinea pigs. For the subsequent 100 and more passages this strain has regularly killed chick embryos on the third day after inoculation and stained yolk sac preparations have shown just as many rickettsiae as any of our highly virulent strains, yet guinea pigs inoculated intraperitoneally with as much as 1 cc of a 10 per cent. yolk sac suspension have either failed to show any febrile reaction or at most exhibit a slight temperature rise lasting not more than 1 or 2 days. Animals injected subcutaneously with similar suspensions seldom show any reaction. In fact, we have titrated yolk sac suspensions of this avirulent, *variabilis* strain on numerous occasions and found that inapparent, immunizing infections resulted in guinea pigs receiving dilutions as high as 1 to 100,000. However, the important finding is that these animals, even when completely afebrile, are later solidly immune to massive doses of highly virulent strains. Furthermore, identical results have been obtained in rhesus monkeys. Attempts to reestablish this strain in guinea pig passage by transfers of blood, testicular washings and spleen suspensions have thus far failed.

Long-term tests are now under way to determine if the degree of protection afforded by this avirulent strain is as solid and lasting as that produced by killed vaccines. Theoretically, we believe it should be even more so. If this proves true, we may eventually be able to immunize man with modified, living strains of spotted fever virus in much the same way as we now immunize against yellow fever. We already have evidence that European typhus, endemic typhus and American and Australian "Q" fever as well as certain other rickettsial strains may similarly be modified in virulence for mammalian hosts by prolonged maintenance in eggs.

## RAFINESQUE'S INTERESTS—A CENTURY LATER: MEDICINAL PLANTS<sup>1</sup>

By Dr. H. B. HAAG

DEPARTMENT OF PHARMACOLOGY, MEDICAL COLLEGE OF VIRGINIA, RICHMOND

To have been selected to participate in this Centennial Memorial to Constantine Rafinesque brings to me feelings of profound humility, on the one hand, those of great satisfaction on the other; humility because the mental stature and achievements of Rafinesque so dwarf those of ordinary men as to make

him almost legendary; satisfaction because of the honor so deeply felt in being allowed to become affiliated with this magnificent occasion and because, secondly, it gives me an opportunity of expressing thoughts concerning plant drugs which I have entertained for some time silently. I was indeed happy when Dr. Brown assigned me the subject dealing with some of the problems within the field of medicinal plants.

<sup>1</sup> Part of a symposium during the Rafinesque Centennial Memorial, Transylvania College, Wednesday, October 30, 1940, Lexington, Ky.

It might be of interest first to discuss the status of medicinal plants at about the time Rafinesque was teaching medical botany here in the medical department of Transylvania College, and to mention some of the factors which were then beginning to make their effects felt on the popularity of vegetable drugs. In the early nineteenth century our national conscience, medically, was awakened to the need of standardizing in some fashion the quality of the medicinals then in vogue. This led the New York Medical Society, through the initiative of Dr. Lyman Spalding, on March 4, 1818, to circularize the several medical bodies with the view of calling together representative district assemblages in 1819. These gatherings were to inaugurate the formation of a convention, the fruits of which were eventually to be our first national Pharmacopoeia; our first authority on drug standards. It is pleasing to note that the Medical School of Transylvania College was among those institutions which approved this movement. In April of 1819 the college administrators appointed Dr. B. W. Dudley and Dr. W. H. Richardson as their official delegates.

The Pharmacopoeia which resulted from these and other deliberations came into being in 1820, and its decennial revisions have come down to us, the present one being unquestionably the world's best Pharmacopoeia. In its preface this first national drug authority states: "It is the object of a Pharmacopoeia to select from among substances which possess medicinal power, those, the utility of which is most fully established and best understood; and to form from them preparations and compositions, in which their powers may be exerted to the greatest advantage."

Approximately 650 drugs and preparations were listed in this first book, of which about 70 per cent. were of vegetable origin. Of these, the usefulness of slightly more than 100 is still recognized by their incorporation in the present eleventh revision of the Pharmacopoeia. These include such important drugs as digitalis, hyoscyamus, belladonna, opium, cinchona and, of course, castor oil. Among those that have fallen by the wayside are "Cornu cervi (Stag's horn)," "Dracontium (Skunk cabbage)," "Dolichos (Cowhage)," "Magnolia" and "Tobacco." Whisky, now official, was absent from the first Pharmacopoeia. There have been some few dozen other additions as exemplified by chaulmoogra oil, aspidium, cascara, strophanthus and various plant derivatives such as cocaine, ephedrine, physostigmine and the caffeine group.

The isolation of morphine from opium in 1804 not only stirred interest in similar chemical studies of the active principles of other vegetable drugs, but seems

to have led to a more profound study of organic chemistry generally. This eventuated in the synthesizing of alcohol by Henry Huenel in 1826 and of urea by Wöhler in 1828. The beginning of synthetic chemistry marked the first major deviation from the interest in vegetable drugs since the time of Paracelsus in the fifteenth century. But another force was to be felt. The study of physiology was simultaneously developing and gathering momentum under such masters as Magendie, Flourens, Johannes Mueller and DuBois-Reymond. This study of function naturally led to study of the various chemicals which might influence function—the beginning of pharmacology. The early workers in pharmacology soon showed that many of the vegetable drugs then in clinical use were devoid of any beneficial action. So informed, the already therapeutically exasperated physician, swinging to a point of juxtaposition, felt that possibly little of therapeutic merit was to be found in any drug, particularly those of vegetable origin. As a result it was not unnatural for a period of therapeutic nihilism to ensue as the nineteenth century reached its three-quarter mark. To further the unfortunate plight of vegetable drugs, physiologists and pharmacologists devoted more and more of their time to synthetic compounds, usually organic ones and to drugs of animal origin. The desertion of the study of vegetable drugs soon became almost complete; at the present time researches dealing with plant medicinals are relatively rare and are becoming more so. To-day is the heyday for organic synthetic chemicals. Present-day medical scientists only too frequently are apt to look askance at those who would investigate the therapeutic possibilities of the vegetable kingdom.

In spite of this loss of dignity, out of a total of approximately 570 drugs and preparations in the present Pharmacopoeia, there are still about 260 (or 45 per cent.) of vegetable origin. These figures must not be too encouraging; many of these drugs are included, not so much because of any belief as to their inherent therapeutic value, but because of their usefulness as pleasant vehicles for the more popular non-vegetable remedies. And further, the indications are that the next pharmacopoeia will contain still fewer drugs of vegetable origin.

In face of such observations, is it justifiable to assume that we have exhausted the medicinal value of plant drugs? The answer is a most emphatic No!

Let us immediately recognize that even at the present time some of our most valuable drugs spring from vegetable sources. Such old drugs as opium, digitalis, cinchona, belladonna and ergot still remain almost unchallenged by synthetic opponents. As studies have been made in more recent times the value

of other plant drugs and preparations has been definitely established. Such studies have led to the introduction of ephedrine, picrotoxin, curare, and others. Again, renewed attention to the older vegetable drugs has led not only to new uses, such as the successful use of belladonna in the treatment of certain diseased conditions of the central nervous system, but also to the discovery of new, therapeutically valuable principles, as exemplified by the recent isolation of the alkaloid ergonovine from ergot. This alkaloid, incidentally, was discovered years after it was supposed that all the active principles of ergot had been detected. That more has not been done is undoubtedly due to the lagging interest in drugs from this natural source. In addition to the reasons previously mentioned, this neglect is further explained because of the intense research activity shown by the chemical industries seeking new drugs in the synthetic field, which can be fairly readily protected from competition by suitable patents. Protection is more difficult in the case of studies concerning vegetable drugs. The field for exploitation is far greater in the case of synthetics than it is for that of the later group. This is not stated to disparage those responsible for the destinies of our chemical and pharmaceutical houses; these concerns have made many excellent contributions. They must look after their own interests, however, and they, as is natural, also tend to follow the custom of the day.

We have but scratched the surface in our study of medicinal plants. We have fairly well classified botanically the plants which inhabit our world; relatively their chemistry and particularly their pharmacology have been ignored. If only for purely scientific reasons this should not be so.

Now during this period of national emergency, it would be most important to know more about our national resources from the point of view of plant medicinals. Forgetting the possibilities offered by unstudied plants, it would be comforting if we had in cultivation in our country the vegetable drugs on which we lean so heavily. Of the five drugs mentioned above (opium, digitalis, cinchona, belladonna and ergot) we raise appreciable quantities of digitalis alone. Had we but found it possible to follow seriously Rafinesque's example in sponsoring a drug farm at Transylvania College, the picture would be different. It should be stated that this deficiency is due largely to economic factors. To those who are interested in following the rise and decline in medicinal plant culture in this country, I would recommend the excellent article by A. F. Sievers published in the *Journal of the American Pharmaceutical Association* for September, 1940.

It is interesting and instructive to follow the devel-

opments, often dramatic, which so frequently characterize the course of thorough observations on vegetable drugs. The leaf of the tree *Erythroxylon Coca* will serve as one good example. The early explorers of the Andes noted that the natives chewed an alkaline cud made of these leaves and, presumably as a result, they were enabled to work prodigiously without fatigue and to go unfed for days without hunger. The Shamans, the priest-doctors of old Peru, were observed to follow a similar custom but for a different purpose. They treated with their spittle the wounds of the patients on whom they had operated, and by so doing gave to their patients surcease from pain. This crude procedure represents the first practice of local anesthesia. Centuries pass. In 1855 and again in 1860 chemical studies in Germany revealed the presence of an alkaloid in extracts of the leaves. It was variously called erythroxylene and cocaine. That the alkaloid produced anesthesia when applied to the tongue led to no suggestion as to its use in man. This awaited the advice of the pharmacologist Anrep, who in 1879 subjected the active compound to a careful study of its action, and as a result he recommended its use to produce local anesthesia in humans. But more was needed to convince the contemporary medical opinion. As evidence of the still degraded status of cocaine in the therapeutic armamentarium of the day, it is to be noted that in 1880 a distinguished medical commission in Great Britain designated it as of little therapeutic importance: at best only a poor substitute for caffeine as a stimulant. Four years later two young scientists in Vienna began anew studies on the action of cocaine. One was to distinguish himself later in a different field—he was Sigmund Freud. The other was to become the father of modern local anesthesia, Carl Koller. Because of pressure from other duties Freud soon left Koller to carry through the studies that they began jointly. After noting that a water solution of cocaine produced deep anesthesia, in the eye of the animal into which it was dropped, Koller tried it on himself and on his friends. Then, being an ophthalmologist, he tried it as an anesthetic in operations on the human eye. Other investigators soon showed that when brought into contact with any sensory nerve it could temporarily block the passage of impulses. It was soon used in dentistry to block those nerves carrying painful impulses from the teeth. Surgeons, among them notably Dr. William S. Halsted in this country, proposed it not only for such use but for other types of so-called "conduction anesthesia." Soon, however, it was found that cocaine has two great disadvantages. It belonged to that group known as "habit-forming" drugs; and, because of self-experimentation for the

sake of science, at least one of the early investigators became a cocaine addict. It is gratifying to know that he subsequently cured himself. The second early recognized disadvantage was that this substance could at times have an alarmingly poisonous effect when used on human beings. A suitable substitute was needed. The time now was at the turn of the present century. The chemical formula for cocaine was by now so well known that pharmacologists could study various degradation products with the view of determining what part of the cocaine molecule was responsible for its benumbing action. Once this was known the chemist synthesized a series of compounds based around this active nucleus. These substances were then studied and compared with cocaine in the medical laboratory as to action, toxicity and, if possible, tendency to habit formation. One result of these observations was the introduction in 1905 of *nevocaine*, or *procaine* as it is listed in the present *Pharmacopoeia*. This is a compound low in toxicity, satisfactorily active as a local anesthetic and devoid of the curse of habit formation. In all but its inability to produce anesthesia except when injected in close proximity to nerves, it has most of the advantages of cocaine and none of its disadvantages. To-day many other cocaine substitutes are available. Most of them, however, depend on the presence of the active cocaine nucleus for their therapeutic efficacy. And so it goes with other drugs. From the vegetable drug we learn a fundamental action, a definite clue, and then set about to improve that which gives to the natural drug its beneficial effect.

The story of opium is equally fascinating; unfortunately, the solution of the problems which now restrict its usefulness has not been solved with the same degree of satisfaction as is the case of the leaves of the "coca" tree.

The use of opium is recorded in our earliest medical archives. Mention is made of it in the Egyptian papyrus discovered in 1872 by Georg Ebers, which reveals the more popular medicinals as of the year 1552 B.C.

Collected as the juice from the poppy capsule it was used more or less in this rather crude form until the English physician Sydenham in the seventeenth century refined it into a tincture which he then called "laudanum." Epochal in its significance was the further refinement of opium therapy when Sertürner, the German apothecary, isolated morphine from opium in 1804. By animal experimentation and trial on several of his friends and himself he determined this compound to be the major active constituent of opium.

Although it had long been known that opium is a most notorious habit-forming drug, relatively little

attention was paid to this problem until the turn of the present century. Then legal measures were instituted with the hope of controlling, in part at least, this marked disadvantage. But more than legal means was needed, and attempts were then made, primarily by pharmaceutical manufacturers, to find opium substitutes having the desired opium effect but free from addiction tendencies.

While some progress was made much remained to be desired. And so in 1929 a program of research was begun under the auspices of the Committee on Drug Addiction of the National Research Council. Under this cooperative scheme, the synthetic chemist, the pharmacologist and the physician all work together towards a single goal—the discovery of an ideal narcotic which could replace morphine, heroin and other similar drugs without fear of addiction. Scores of synthetic compounds bearing chemical resemblance to the natural alkaloids of opium have been synthesized and tested on animals. Some of the more promising ones have been extensively studied by the clinical component of the research triad here in Lexington under the supervision of Dr. C. K. Himmelsbach in the U. S. Health Service Hospital. While the results have been encouraging the ideal substitute has not yet been found, and so the search goes on. Here again is an example of a natural plant gift which is unrivaled in its therapeutic ability and which, due to the studies to which it serves as a cue, may eventually be the instrument whereby human suffering may be relieved to an extent never before realized and with complete safety.

Now in conclusion, from this brief summary of the chemical and pharmacological status of our knowledge of plants, three facts present themselves boldly: (1) Botanical knowledge abounds while chemical and pharmacological information concerning plants is relatively scarce. (2) Drugs belonging to the vegetable kingdom are to be found among our most important medicaments, and so we have reason to have faith in plants as a source of drugs. (3) The potentialities of the vegetable kingdom as a source of useful drugs have by no means been adequately studied.

The logical deduction is obvious. The time seems propitious for an extensive study of plant medicinals, for earnest consideration of the establishment of an institute to systematically study the chemistry and physiological action of members of the vegetable family. The rewards may be astounding, and at any event they would justify themselves solely on the grounds of scientific inquiry. We might not find another sulfanilamide, but we might find another *digitalis*, another *belladonna*, another opium. I believe that *Rafinesque* would have approved of this idea.

## OBITUARY

## AUGUST H. WITTENBORG

AUGUST H. WITTENBORG, professor of anatomy, head of the department of anatomy, chief of the division of anatomy and formerly dean of the Memphis Colleges of the University of Tennessee, died on August 21, 1941, at Ann Arbor, Michigan. His final illness was the culmination of a progressive heart disease which had compelled his leave of absence from university duties during the academic year immediately preceding his death.

Having received his preliminary education in Germany, he entered the College of Physicians and Surgeons in Memphis in 1906 and graduated therefrom in 1910 with highest honors in medicine. In his senior year he was student instructor in medical biology. During the year immediately following graduation he studied in Berlin, Vienna and other European medical centers.

Returning to Memphis in 1911, he entered private practice and became associated with the College of Physicians and Surgeons as instructor in physiology.

In 1912, when the College of Physicians and Surgeons was merged with the University of Tennessee Medical School, Dr. Wittenborg joined the staff on a full-time basis as professor and head of the department of anatomy. He retained this appointment until his death. With the organization of the faculty into divisions, in 1925, he became chief of the division of anatomy and served in this capacity also until his death.

From 1917 to 1919, Professor Wittenborg served as dean of the College of Medicine. To his devotion and courage during this critical time in the history of the college must go a major share of credit for its survival. Again, in 1921, during another crisis in the affairs of the College of Medicine, he was acting dean of this college for three months.

No statistical recital can describe the unique distinction which Professor Wittenborg enjoyed among his colleagues and students. It is difficult to express the affection and esteem in which he was held. He touched profoundly the lives of those with whom he came in contact. Students brought their personal problems to him, and returning graduates rarely failed to visit him.

His complete intellectual and personal honesty, his profound scholarship, his intuitive powers of human analysis, his incisive but kindly humor, his lively and stimulating imagination, his warm and vivid personality, the sincerity and friendliness of his interest, were qualities which made for his greatness as a teacher. His loyal devotion to the university and his high order of courage were potent factors in developing and sustaining proud standards of discipline among students

and faculty. He was incapable of a mean or selfish act.

Professor Wittenborg published but little in his lifetime and was not therefore well known outside of his immediate group of colleagues. He was elected to membership in the American Association of Anatomists in 1924. He did not belong to that school which believes that medical students can learn anatomy when merely left to themselves with cadaver and text. His was a very dynamic and energetic form of teaching, one which drove home the important facts of anatomy through the frequent use of homely similes, embryological references and correlations between morphology and physiology. He believed that it was inexcusable for the anatomy teacher not to give the student the benefit of his anatomical experience, and thus to help him to acquire more easily a working knowledge of this important and difficult subject. Although he did not believe in the formal lecture in teaching anatomy, his group discussions, in which he searchingly quizzed the students, conveyed much more factual material to his listeners than do most lectures. He devoted his life to the teaching of anatomy, and probably he has had few equals as a teacher of this subject.

O. W. HYMAN  
R. L. CROWE  
T. P. NASH, JR.  
K. B. CORBIN

UNIVERSITY OF TENNESSEE

## DEATHS AND MEMORIALS

DR. WILLIAM ALBERT NOYES, professor of chemistry and director emeritus of the Chemical Laboratory of the University of Illinois, died on October 24 in his eighty-fourth year.

*Nature* announces the death of H. S. Ball, principal of the School of Metalliferous Mining, Cornwall, on September 26, aged fifty-three years, and of R. T. Baker, formerly curator of the Technological Museum, Sydney, an authority on Australian eucalypts and pines, on July 14, aged eighty-six years.

THE meeting of the New York Academy of Medicine on October 2 was devoted to the memory of the late Sir Frederick G. Banting. Dr. Charles H. Best, who succeeded Dr. Banting as director of the department of physiology and the department of medical research of the University of Toronto, made a memorial address and a scientific address on "Prevention of Diabetes from the Experimental Viewpoint," and Dr. Elliott P. Joslin, Boston, spoke on "The Use of Insulin in Its Various Forms in the Treatment of Diabetes."

## SCIENTIFIC EVENTS

### DAMAGE TO THE UNIVERSITY OF LONDON AND ITS HOSPITALS

In his annual report, the principal of the University of London, according to the London correspondent of the *Journal of the American Medical Association*, H. L. Earson, states that the intensive air raids on London fully justified the policy of dispersal adopted by the schools of the university in the summer of 1939. The damage to university buildings has been so severe and widespread that if the schools had been in London the work would have virtually come to an end for a time. The two most important schools are University College and King's College, which are each attached to a great hospital. University College has been repeatedly attacked by high explosive and incendiary bombs, and a large part of its buildings have been destroyed. About a hundred thousand of its books in the library have been damaged beyond repair by fire and water. King's College has been damaged to a less extent, but two of its hostels and its library have been severely damaged. About one third of Bedford College (for women) has been destroyed by fire. Birkbeck College has been damaged twice, many laboratories, the operating room, books and equipment being destroyed. Damage to a less degree has been done to King's College of Household and Social Science, the Imperial College of Science and Technology and the School of Oriental Studies. The London School of Hygiene has been severely damaged by high explosives.

The hospitals of the medical schools of the university have been severely damaged almost without exception, but, owing to the decentralization of staff, students and patients under the emergency medical service, medical education has been maintained at a high level. The Medical School of St. Bartholomew's Hospital has been almost completely destroyed, and the London School of Medicine for Women has been damaged considerably. The buildings of other medical schools have sustained little damage. Notwithstanding decentralization and delays and difficulties due to disturbance of communications, the work of the university has been maintained at a high level. The number of internal students in 1939-1940 was 25 per cent. less than in 1938-1939 and this year will probably be 40 per cent. below the prewar figure. In spite of exile in strange places and air raids, the performance of students at examinations has little changed, the percentage of passes and honors being much the same as in peacetime.

### THE MOUNT DESERT ISLAND BIOLOGICAL LABORATORY

THE Mount Desert Island Biological Laboratory officially closed its forty-fourth season on September

15. At the annual meeting of the laboratory corporation the following officers were elected: Ulric Dahlgren, Princeton University, *president*; Dwight E. Minnich, University of Minnesota, *vice-president*; John Whitcomb, Bar Harbor, *treasurer*; J. Wendell Burger, Trinity College, *secretary*; Roy P. Forster, Dartmouth College, director of the laboratories. William H. Cole, Rutgers University, and Homer W. Smith, New York University, were elected to serve with the president, director and treasurer on the executive committee.

At the annual meeting of the corporation the following trustees were elected to serve until 1944: U. Dahlgren, Princeton University; J. W. Burger, Trinity College; H. Bumpus, Waban, Mass.; G. Dorr and J. Whitcomb, Bar Harbor. Twelve new members were admitted to the corporation.

The laboratory plant was enlarged during the year by the construction of a new fresh-water laboratory which houses two separate research units. A plan was provided whereby the laboratory will lease some of its shore property at a nominal annual fee to active research workers for use in constructing homes. One home has been completed under this plan and another will be finished by the opening of next season.

### THE PAN AMERICAN CONGRESS OF MINING ENGINEERING AND GEOLOGY

THE first Pan American Congress of Mining Engineering and Geology will be held at Santiago, Chile, during the first fortnight of January, 1942, under the auspices of the Chilean Institute of Mining Engineers, and officially sponsored by the Government of Chile.

The purposes of the congress, as stated in Article 2 of its regulations, are:

To demonstrate the progress achieved in mining and geology on the American Continent.

To analyze and consider solutions of the more important problems in this part of the world in the fields of mining and geology.

To promote a closer friendship and a permanent interchange of opinions and ideas among mining engineers and geologists of the Americas.

Attendance at the congress is open to interested parties who may register as members before December 1, in the following categories:

Official delegates designated by the various governments and duly accredited representatives of institutions.

Graduate mining engineers and geologists who may apply for membership.

Professional and non-professional persons who may be especially invited.

Persons who may wish to attend the congress and whose applications for membership may be accepted by the Membership Committee.

In addition to the above, the congress may designate honorary members.

The agenda consists of an ample coverage of various topics under eight heads as follows: Mining, Geology, Fuels, Ore Dressing and Ore Concentration, Metallurgy, Nitrate, Mining Policy, Legislation and Economy and Mining Education.

The proceedings of the congress will be conducted in Spanish, English and Portuguese, and interpreters will be made available to the members. Various tours will be arranged, which will take the members through the most interesting mining regions of Chile. The Embassy of Chile in Washington, D. C., will furnish additional information upon request.

### THE ATTACK ON THE CITY COLLEGE SYSTEM OF NEW YORK CITY

DR. WALTER RAUTENSTRAUCH, chairman of the New York Branch of the American Association of Scientific Workers, has sent to *SCIENCE* a copy of resolutions passed by the branch on the situation in the colleges of the City of New York, the first and last of which read:

The New York Branch of the American Association of Scientific Workers has observed with deep misgivings the situation arising out of the proceedings of the Board of Higher Education, following the investigations by the Rapp-Coudert Committee of so-called subversive activities in the New York City Colleges. The evidence available points to the dismaying conclusion that the recommendations of the board, based on the committee's alleged findings, negate the fundamental civil and legal rights of the accused, and by tending to suppress freedom of thought and expression of both students and teachers, undermine the morale and seriously impair the educational effectiveness of the City Colleges.

In the light of these circumstances the members of the New York Branch of the American Association of Scientific Workers, as citizens concerned with the preservation of our democratic institutions, vigorously protest against the actions of the Board of Higher Education affecting the accused teachers and administrative workers of the City Colleges. As scientists, moreover, cherishing those conditions of free inquiry and adherence to objective fact so indispensable to the life of science, we are profoundly alarmed by the evidence of bias and unfairness, indeed of inquisitorial methods, in the hearings of the Rapp-Coudert Committee, which furnished the so-called evidence upon which the board acted. We consider it imperative that the Board of Higher Education reconsider its actions in this matter, and reinstate with full back pay all accused individuals pending fair and open hearings on the validity of the charges against them.

### GREETINGS OF SOVIET MATHEMATICIANS TO AMERICAN MATHEMATICIANS

THERE was printed in the issue of *SCIENCE* for October 10 a letter of greetings sent to mathematicians

of Soviet Russia from ninety-three American mathematicians. An answer from Moscow dated October 7 has been received. It reads:

Your splendid message, dear colleagues, found wide response in the hearts of the scientists of our country. We read it with feelings of all the more appreciation and satisfaction in that it again emphasized the community of thoughts and the friendly ties between the mathematicians of the USA and the USSR. Many years we jointly worked with you on the development of our science, many of our American colleagues were our welcomed guests, while with a still greater number of American scientists we conduct friendly scientific correspondence. This mutual cooperation was very fruitful and led to a number of important scientific discoveries.

In recent years our country became the center of gravity for eminent European mathematicians who were forced to flee the lands downtrodden by the hell of Nazi barbarians.

Our country, too, is subjected to the invasion of these gloomy medieval forces. The Hitlerites seek to smash the USSR in order to afterwards make their forces available for also destroying your great country. The fight now being waged by our people is the fight for the progress of all mankind, for everything advanced, the fight for the flourishing of civilization and of science.

Our science, too, has been placed at the service of our country for the destruction of Nazism. Soviet mathematicians, like all Soviet scientists, participate in this fight in common with the whole people. This struggle of Soviet scientists is the common cause of the scientists of all democracies, against the fiend who shoots children, burns libraries, smashes universities and destroys science.

On this momentous day your message, dear friends, has been received by us as the proof of the unity of Soviet and American scientists and their determination to fight the twentieth century vandals till the end.

Let the friendship of the Soviet and the American scientists be the surety of the friendship of our great nations, the surety of the victory of democracy over the dark forces of Hitlerism.

Among the sixty-four are: A. Sobelev, director of the Steklov Mathematical Institute of the Academy of Sciences, USSR; P. Alexandrov, president of the Moscow Mathematical Society, and corresponding members of the Academy of Sciences, USSR, the Ukrainian Academy, professors and readers of the Universities at Moscow, Leningrad, Kiev, Odessa, Kazan, Tomsk, and professors in various other institutes.

### PRIORITY RATING GIVEN TO RESEARCH LABORATORIES

THE substance of a ruling from the Office of Production Management is given in the *Bulletin* of the Society for Testing Materials. Attention is called to

the fact that this rating recognizes the great importance of scientific research in the present National Defense program. The priority rating of A-2 was granted for equipment needed by research laboratories.

The Priorities Division has secured the assistance of the National Academy of Sciences in the operation of the new Research Laboratories Supplies Plan. The academy will advise upon applications from laboratories for assistance under the plan.

A laboratory experiencing difficulty in securing essential materials, and wishing to qualify for the A-2 rating, should apply to the Chemical Branch, Office of Production Management, Washington, D. C., on Form PD-88.

The preference rating may be extended as far as necessary to assure ultimate delivery of scarce materials to the laboratory. A laboratory, when applying for the rating, should specify the number of copies of the order which will be necessary to enable its suppliers to serve them upon their own sub-suppliers. No extensions of the rating to suppliers will be made directly by the Priorities Division. This must be done by the laboratory itself.

In the event that the laboratory finds itself unable to obtain some essential material with the A-2 rating, it should file an application with the Priorities Division on Form PD-1. If the research project is deemed of sufficient importance, the Priorities Division will issue an individual preference rating certificate, assigning a higher rating to a particular delivery of specified material.

All correspondence should be with the OPM Chemical Branch, and not with the National Academy of Sciences.

It is also stated in the *Bulletin* that the fourth in the group of subcommittees which comprises the Advisory Committee on Metals and Minerals appointed by the National Academy of Sciences to cooperate with the Office of Production Management has been organized and the personnel announced; this is the subcommittee on nonmetallic minerals. Groups were formed previously on ferrous minerals and ferro-alloys, metals conservation and substitution and tin smelting. Clyde E. Williams, director of the Battelle Memorial Institute, is chairman of the main advisory committee.

## SCIENTIFIC NOTES AND NEWS

THE Frederic Ives Medal of the Optical Society of America was presented on October 24 to Dr. Selig Hecht, professor of biophysics in Columbia University, in recognition of "distinguished work in the field of optics" at the twenty-sixth annual meeting of the society in New York City. Dr. Kasson S. Gibson, president of the society, presented the medal, which was founded in 1928 by Dr. Herbert E. Ives, of the Bell Telephone Laboratories, in memory of his father. Previous recipients of the medal include Professor A. H. Pfund, the Johns Hopkins University; Dr. Herbert E. Ives; the late Professor George Ellery Hale, the Mount Wilson Observatory; Professor Robert W. Wood, the Johns Hopkins University; Professor Theodore Lyman, Harvard University, and the late Professor Edward L. Nichols, Cornell University.

D. ROBERT YARNALL, mechanical engineer of Philadelphia, Pa., has been selected as the fifth recipient of the Hoover Medal. The medal will be presented to Mr. Yarnall during the annual meeting of the American Society of Mechanical Engineers in New York City, which will be held from December 1 to 5, with the following citation: "D. Robert Yarnall, humanitarian, engineer and a leader in the engineering profession, who rendered outstanding service as a member of a mission that fed the children of Germany at the end of the World War and that is now aiding

refugees in this country and Europe and providing food and relief for the children and mothers of France. These distinguished public services have earned for him the Hoover Medal for 1941." The medal was formally instituted on April 8, 1930, during the celebration of the fiftieth anniversary of the American Society of Mechanical Engineers, to commemorate the civic and humanitarian achievements of Herbert Hoover, to whom the first award was made. It was awarded to Dr. Ambrose Swasey in 1936, to John Frank Stevens in 1938 and to Gano Dunn in 1939.

DR. GEORGE W. CORNER, director of the department of embryology of the Carnegie Institution of Washington at Baltimore, has been elected a foreign corresponding member of the National Academy of Medicine of Argentina.

DR. CARL EPLING, professor of botany of the University of California at Los Angeles, will give the Faculty Research Lecture for the academic year 1941-42. This lecture is given annually by "an outstanding scholar or scientific man who has made significant contributions to the world's knowledge."

At Yale University Dr. Alan M. Bateman, professor of economic geology, has been made Silliman professor of geology. Emeritus professors Horace S.

Uhler and John Zeleny have been appointed lecturers in physics.

PROFESSOR KENNETH K. LANDES, chairman of the department of geology of the University of Kansas and State Geologist of Kansas, is the new chairman of the department of geology of the University of Michigan.

DR. DONALD E. BOWMAN has resigned as instructor in biochemistry at the School of Medicine, Western Reserve University, to accept an appointment as assistant professor of biochemistry at Indiana University School of Medicine, Indianapolis.

WILFRED B. YOUNG, associate professor of animal husbandry and extension animal husbandman, has been appointed director of a school of agriculture for two years training on vocational lines organized at the College of Agriculture of the University of Connecticut.

DR. JAMES A. BABBITT, emeritus professor of clinical otolaryngology of the School of Medicine of the University of Pennsylvania, has been chosen president-elect of the American Academy of Ophthalmology and Otolaryngology to take office on January 1, 1943. Dr. Ralph I. Lloyd, of Brooklyn, N. Y., will become president on January 1.

DR. W. H. MILLS has been elected president of the British Chemical Society until the next annual general meeting.

DR. CLARENCE HISKEY and Dr. Harold Brailey, who were seriously burned in a chemical explosion at Columbia University on October 20 are reported to be recovering. Dr. Walter H. Zinn, research physicist, also of Columbia University, suffered second-degree burns of both hands on October 24 in a second laboratory explosion.

THE National Foundation for Infantile Paralysis has made a grant of \$4,250 to the University of California Medical School, San Francisco, for the continuation of a study of methods of restoring lost power to paralyzed limbs. The work is being carried out by Drs. John B. de C. M. Sauters, professor of anatomy and lecturer in medical history and bibliography; LeRoy C. Abbott, professor of orthopedic surgery, and Verne T. Inman, clinical instructor in orthopedic surgery.

DR. E. RUFFIN JONES, JR., professor of biology at the Norfolk Division, College of William and Mary-Virginia Polytechnic Institute, has been appointed chairman of the faculty of that institution.

DR. JOHN N. McDONNELL, assistant professor of pharmacy at the Philadelphia College of Pharmacy

and Science and editor of *The American Professional Pharmacist*, has been appointed head of the health supplies and drug division of the Bureau of Research and Statistics of the Office of Production Management in Washington.

DR. G. R. TATUM, professor of physics at Baylor University, has been granted leave of absence for the session of 1940-41 in order to serve as a member of the staff in the Cruft Laboratories, Harvard University, for the training of Army officers in the use of airplane detection apparatus. Dr. Tatum is in charge of the laboratory experiments and the conference sections of the course. Approximately a hundred Army officers began the course on October 1.

AN expedition from the Field Museum of Natural History, which has as one of its objectives the determination of the date at which the Isthmus of Panama emerged from the sea, will leave for Central America in November. Paul O. McGrew, assistant curator of paleontology, and Albert Potter will leave from Chicago on November 2. They will sail from New Orleans on November 5 to Puerto Cortez, Honduras, whence they will fly to the capital, Tegucigalpa, and thence to the town of Gracias. From Gracias they will use mules for transportation while doing their field work.

DR. W. D. FUNKHOUSER, dean of the Graduate School and head of the department of zoology of the University of Kentucky, has been granted leave of absence for the year 1942 to make a collecting trip in Central and South America.

DR. ZING-YANG KUO, director of the Institute of Physiology and Psychology at Chungking, China, has visited England at the request of the Chinese Minister of Education and by invitation of the Universities' China Committee in London to seek to promote closer and more effectual cultural and educational cooperation between the two countries. After attending the conference of the British Association and a brief stay in London he visited Oxford, Cambridge, Manchester, Glasgow and other educational centers.

PROFESSOR GEORGE B. CRESSEY, chairman of the department of geology and geography at Syracuse University, spoke before the North Central Indiana Teachers Association in South Bend on October 24. In the morning he discussed "The Use of Maps in the Study of Current Events" and in the afternoon presented an illustrated lecture on "Far Eastern Geographic Strategy." The latter is also the subject of a Littauer Lecture at Hunter College in New York City on November 13.

SIR WILLIAM JAMESON, chief medical officer of the Ministry of Health, London, delivered the Cutter Lecture on Preventive Medicine at the Harvard Med-

ical School on October 22. His subject was "Public Health in Britain at War."

A CONFERENCE on "The Ultracentrifuge" will be held by the Section of Physics and Chemistry, the New York Academy of Sciences, on November 14 and 15 in the Roosevelt Memorial Building of the American Museum of Natural History. There will be an informal subscription dinner on Friday evening. Attendance will be limited to those invited to participate in the conference and to interested members of the academy.

THE fourth annual meeting of the Research Council on Problems of Alcohol will be held in New York City on November 25. There will be ten group conferences at 11:00 A.M. and a luncheon at 1:00 P.M. Dr. Edward A. Strecker, professor of psychiatry and chairman of the department at the University of Pennsylvania, will give the luncheon address.

THE Acoustical Society of America met at the Hotel Pennsylvania on October 24 and 25, under the presidency of Dr. E. C. Wentz, research physicist of the Bell Telephone Laboratories. Noise abatement was one of the principal subjects considered. Many of the thirty-six papers presented were accompanied by demonstrations of the devices under discussion, which included recording and record-playing equipment, hearing aids and the devices employed by the Library of Congress in making and preserving an auditory record of our civilization. A joint luncheon of the Acoustical Society of America, the Optical Society of America and the Society of Rheology was presided over by Dr. Paul E. Klopsteg, chairman of the governing board of the American Institute of Physics. Dr. Vannevar Bush, president of the Carnegie Institution of Washington and director of the Office of Scientific Research and Development, addressed a joint meeting of the three societies.

THE semi-annual meeting of the American Association on the History of Medicine was held on October 24 and 25 at the Medical School of the University of Kansas, Kansas City, under the auspices of the Quivira Medical History Club of Western Missouri and Kansas.

THE fiftieth anniversary of the opening of the Ladd Observatory was celebrated by Brown University with a reception at the observatory on the afternoon of October 21 and a lecture in the evening by Professor Frederick Slocum, of the class of 1895, director of the Van Vleck Observatory at Wesleyan University, formerly professor of astronomy at Brown University. An exhibition of early astronomical instruments, including the transit used by Professor Benjamin West at the university in 1769,

was on display. The gift of former Governor Herbert W. Ladd, of Rhode Island, the observatory was opened in 1891 after having been built and equipped at a cost of \$25,000. Its principal instrument is a 12-inch refracting telescope. Professor Charles H. Smiley, director of the observatory, announced that the next expedition from Brown University will go to South America to photograph the total eclipse of the sun on January 25, 1944. Professor Smiley took part in eclipse expeditions to Peru and Brazil in 1937 and 1940.

UNDER the sponsorship of the U. S. Office of Education through its Engineering, Science and Management Defense Training Program, and in cooperation with the U. S. Department of Labor through its National Committee for Conservation of Manpower in Defense Industries, the Greater New York Safety Council and the Center of Safety Education at New York University, the College of Engineering at New York University is planning to set up at various centers in the metropolitan area a course in accident prevention and safety engineering.

THE fourteenth annual Graduate Fortnight of the New York Academy of Medicine was opened formally on the evening of October 13 with an address of welcome by the president, Dr. Malcolm Goodridge, to seven hundred registrants and attending fellows of the academy. The subject under consideration was "Cardiovascular Diseases Including Hypertension." Reviews of various aspects of the subjects were given at the evening sessions by twenty-six lecturers. There were a hundred and eighteen clinical conferences and demonstrations held in fourteen hospitals and clinics of Greater New York.

ANNOUNCEMENT has been made by the Finney-Howell Research Foundation that all applications for fellowships for next year must be filed in the office of the Foundation, 1211 Cathedral Street, Baltimore, Md., by January 1. Applications received after that date can not be considered for 1942 awards, which will be made the first of March, 1942. This foundation was provided for in the will of the late Dr. George Walker, of Baltimore, for the support of "research work into the cause or causes and the treatment of cancer." The will directed that the surplus income from the assets of the foundation together with the principal sum should be expended within a period of ten years to support a number of fellowships in cancer research, each with an annual stipend of two thousand dollars, "in such universities, laboratories and other institutions, wherever situated, as may be approved by the Board of Directors." Fellowships carrying an annual stipend of \$2,000 are awarded for the period of one year, with the possibility of renewal up to three

years; when deemed wise by the Board of Directors, special grants of limited sums may be made to support the work carried on under a fellowship.

THE Committee on Scientific Research of the American Medical Association invites applications for grants of money to aid in research in problems bear-

ing more or less directly on clinical medicine. Preference is given to requests for modest amounts to meet specific needs. As a rule grants are not made for the purchase of equipment or apparatus of a permanent nature. For application forms and further information, address the committee at 535 North Dearborn Street, Chicago.

## DISCUSSION

### AURORAL DISPLAY AND GEOMAGNETIC STORM OF SEPTEMBER 18-19, 1941

ONE of the greatest auroral displays ever observed in the central Atlantic and mid-central portions of the United States occurred on the night of September 18-19. Spectacular displays continued from twilight until just before dawn, and were observed as far south as Florida and southern California. The auroral activity accompanied one of the most violent magnetic storms of the present sunspot-cycle, nearly equaling in intensity and exceeding in duration the great storm of Easter Sunday, March 24, 1940. Serious interference with radio and wire communications over long distances was experienced, as well as noticeable effects on electric power-transmission lines.

This geomagnetic storm is generally ascribed to clouds of electrified particles projected from the sun in the region of an extraordinarily active sunspot-group which had crossed the solar meridian shortly before the onset of the disturbance. The progress of this sunspot-group across the sun had been followed by a number of observers for several days. Just at the time of crossing the solar meridian an increase in activity in the group was noted. Since such active groups frequently give rise to geomagnetic disturbances, H. W. Wells, of the Department of Terrestrial Magnetism, Carnegie Institution of Washington, had warned numerous radio operators to be on the lookout for disturbances in radio transmission-conditions, so that occurrence of the magnetic storm was not entirely unexpected by scientists, although its great intensity and the extent of the auroral manifestations were not anticipated.

The storm began at 11 P.M., Eastern Standard Time, on September 17 and attained maxima of activity between 1 and 3 P.M., and between 7 and 10 P.M. on September 18. During both of these periods of intense activity, effects were noted on the 230-kilovolt inter-connecting line tying the power-system of Washington, D. C., into the hydroelectric developments along the Susquehanna River in Pennsylvania, approximately 100 miles to the north. The second period of disturbance also was the time of maximum auroral activity. Changes in horizontal magnetic intensity at

the U. S. Coast and Geodetic Survey Observatory at Cheltenham, Maryland, amounted to over 2,500 gammas, which is approximately 15 per cent. of the normal value at that station, the greatest change ever recorded there.

During the second active interval, which occurred during the hours of darkness, bundles of auroral rays were directed downward through the high atmosphere over the eastern section of the United States. These rays, because of the electrical nature of the particles causing them, took the direction of the earth's magnetic field and consequently assumed roughly parallel directions and approached the earth's surface in alignment with the magnetic dip which at Washington, D. C., is nearly  $20^\circ$  from the vertical. To observers viewing these rays they appeared to be parallel, and like all parallel lines, appeared to converge in the distance. For this reason many persons noted a spectacular coronal display of the aurora borealis where the rays appeared to converge slightly south of the true zenith toward a point known as the magnetic zenith.

Throughout the night the auroral activity exhibited various forms. At times extensive quiescent auroral arcs crossed the sky in a roughly east-west direction. These changed into draperies, rays and curtains, as the various auroral forms are picturesquely described. In the extreme northern part of the country and in southern Canada brilliant colors in the aurora were reported by many observers, although throughout the greater portion of the United States the auroral forms were with little color although occasional casts of red and green could be detected. Auroral displays were observed in the northern part of the United States on the nights of September 17-18 and 19-20 also, but of greatly diminished intensity.

No complete theory of geomagnetic storms and aurora has been developed. The most generally accepted theory attributes both to the injection into the earth's atmosphere of high-velocity electrified particles projected from active regions on the sun. These particles, entering the tenuous layers of the upper atmosphere, excite the molecules and atoms of the air and thus give rise to the auroral light in very much

the same manner as glows are produced in neon signs. The energies of these particles also ionize the atmospheric gases and render them electrically conducting so that large electric currents flow through the upper atmosphere. These produce the magnetic effects recorded by magnetic instruments and also induce electric currents in power and telegraphic lines. This electrification of the upper atmosphere is irregular in formation and consequently destroys the reflecting properties of the smooth but lesser conducting layers normally present which are responsible for reflection back to earth of radio waves traversing long distances. During the magnetic storm of September 18-19 electric currents flowing in the earth's atmosphere probably attained values of several million amperes.

Magnetic storms of intensity comparable with the recent one are extremely rare, occurring as a rule only once or twice during each sunspot-cycle. Since the present sunspot-cycle is now well on the decline, it is extremely unlikely that so great a magnetic storm accompanied by a spectacular auroral display will occur again for a considerable number of years.

A. G. McNISH

DEPARTMENT OF TERRESTRIAL MAGNETISM,  
CARNEGIE INSTITUTION OF WASHINGTON

### MOSSES IN THE VIRGINIA CAVERNS<sup>1</sup>

RECENTLY when on a visit to Luray Caverns in the Shenandoah Valley of Virginia I was surprised to see a pronounced green color appearing on many of the drip-stone formations that I had not noticed many years previously. It was evident that this green coloration was related in some way to the illuminating system, for it showed at its best on the rocks brilliantly lighted by the reflecting projectors. On close examination it was found to be a chlorophyll plant. A specimen submitted to the Farlow Herbarium of Harvard University was determined as an atypical sterile moss of the Order Hypnobryales.<sup>2</sup> More recently a collection of these mosses has been submitted to the Harvard herbarium for more specific identification.

Before the electric illuminating systems were installed in the Virginia caves no sign of moss or other green plant life had been seen in their dark interiors. The lighting systems were installed in most of the caves about 1922 or shortly thereafter. The moss is variously reported to have appeared in two months to two years time after the lights were put in service. With the introduction of larger bulbs and more efficient reflectors, the moss has spread over wider areas

to the extent that the green tone is almost as much a part of the coloration of the cavern as the natural browns, buffs and white of the drip-stone formations. This greenish color is not objectionable but rather adds a pleasing variation to the natural color scheme.

Apparently the spores of mosses living on the surface of the ground above the caves are carried by the ground-water seepage into the caves. If they are fortunate enough to lodge within an intensely illuminated area the spores germinate and develop into mosses as much as two to three inches in length. Even ferns have been reported to grow in the caves.

Whether these mosses require the light and heat from the visible range of the spectrum or whether they can develop in total darkness under the influence of infra-red radiation is not known. But certain it is that they have not been able to germinate in these caves without the support of radiation from the electric lamps. The amount of light, or rather the extent of the time of illumination, may range from an hour or two to fourteen hours a day, depending upon the season of the year. In summer, the busy tourist season, the plants in the caves may be bathed with artificial light for as many hours a day as if they were living outside. In winter when the periods of illumination are short the plants may turn yellowish or brown and die.

As mosses are land plants their introduction into caves by the vadose waters is a relatively simple process. The wind is not a likely means of transportation of the spores, more particularly in the Luray Caverns where no noticeable air circulation is reported. The spores of mosses are apparently present at all moist places and are awaiting only sufficient light to germinate, and they in turn provide a means of support for animal life which exists with them. Algae on the other hand are water plants and their continuous introduction into areas above the water table is not so likely. Where surface streams become cavern streams there is apparently no reason why algae may not grow in caverns under the influence of sufficient artificial illumination.

WALTER B. LANG

U. S. GEOLOGICAL SURVEY

### STONE MAN CAVE, SHASTA COUNTY, CALIFORNIA

INVESTIGATION of cave deposits in northern California was initiated in 1903 by Dr. John C. Merriam, and excavations were carried on up to and during 1905, principally in the Potter Creek and Samwel Caves. One cave, the Stone Man Cave, approximately 30 miles north of Redding, was examined by Dr. Merriam and the writer, but some doubt existed as to its antiquity, owing to the paucity of animal remains in the cave.<sup>1</sup>

<sup>1</sup> *Am. Anthropologist* (NS) 8: 2, April-June, 1906.

<sup>1</sup> Published by permission of the Director, U. S. Geological Survey.

<sup>2</sup> Through the kindness of Dr. Franz Verdoorn, the specimen was subsequently forwarded to Professor W. C. Steere, of the University of Michigan. He pronounced it to be *Leptobryum pyriforme*.

Recently, through the interest of Mr. H. Wallace Buckingham of Redding, who visited the Stone Man Cave, more information has been available regarding the age of the deposits found in it. In company with Mr. Buckingham, and by support of the Carnegie Institution of Washington through Dr. Merriam the cave was reexamined by the writer and a small collection of fossil bones was obtained.

The Stone Man Cave is topographically higher than Potter Creek Cave and lies north of the Pitt River and east of the McCloud River.

The mammalian remains found in the cave represent a number of species common to the Shasta caves but probably accumulated later than those of Potter Creek and Samwel caves. The presence of *Arctotherium*, the large short-faced bear, *Equus* sp., *Odocoileus* sp. and a number of rodent species suggests a time relationship with that of Potter Creek Cave and Samwel Cave. Split and gnawed parts of limb bones that were so common in the other caves are present.

A statement regarding the avian skeletal material found in Stone Man Cave, as reported upon by Miss Ida DeMay, follows:

The bird remains also represent species included in collections from the Shasta caves. A fragment of an ulna may be assignable to *Gymnogyps amplus*, an extinct condor described from Samwel and Potter Creek Cave material by Loye Miller in 1911 (Univ. Calif. Publ., Bull. Dept. Geol., vol. 6, pp. 385-400). This species is the only condor that has been recorded from the Pleistocene of Shasta County. Bone fragments probably representing the sooty grouse (*Dendragapus fuliginosus*) and two bones of the band-tailed pigeon (*Columba fasciata*) also occur in the collection. Both of these species are found in the region to-day.

E. L. FURLONG

CALIFORNIA INSTITUTE OF TECHNOLOGY

### REPRINT SIZE

A SHORT time ago our laboratory inherited a fine reprint collection from a physiologist. The problem

then arose of the best method of making these 10,000 items available to our graduate students. We decided to file them, as we had another reprint collection, in two cabinets of metal containing 5 drawers each with dividers in each drawer. The drawers were 11 × 17 inches.

The trouble then arose of reducing as many reprints as possible to a size less than or equal to 9 × 7 inches. Hence this appeal to secure reprints of standard size, either 9 × 6 or 9 × 7 inches. Isn't the time ripe to ask such journals as the *Proceedings of the Society for Experimental Biology and Medicine* to reduce their size and save the paper we have to shear from their reprints before filing? From the sixteen reprints that came to my desk this morning we sheared 15 per cent. by weight before we could file them.

Furthermore, we keep several sizes of envelopes for mailing reprints. What reason is there for most journals not standardizing their reprint size now?

CLIVE M. MCCAY

CORNELL UNIVERSITY

### LEONHARD STEJNEGER

(For his ninetieth birthday, October 30, 1941)

The sons of science walk in endless line  
Bearing the torch; a few falter and drop,  
But the rest close in: they who have glimpsed a sign  
Far on ahead that reads, "You must not stop!"  
Their quests are strange and wonderful—to bring  
The stars to earth, to take the earth to sky;  
To know the *what* of every living thing  
Of all time past, and then the *how* and *why*.

And here is one whose vision has been long  
And clear and true—he saw the sign ahead.  
His torch was radiant, and he held it strong;  
Where it found darkness there came light instead . . .  
Forever seeking truth, not vain acclaims,  
He kindled, on the way, a thousand other flames.

PAUL H. OEHSE

## QUOTATIONS

### SCIENCE AND WORLD ORDER

THE Conference on Science and World Order, which begins to-day in London under the auspices of the British Association, is an event of considerable importance. The speakers at the meeting will undoubtedly be making valuable contributions toward the problem of sane and efficient reconstruction and the establishment of a stable world order after the war. But the mere fact of such a conference being held at this particular time and in this particular place is also significant. The conference is truly international, and it is free from any trammels on the ex-

pression of opinion. One similarly free and international conference has just been held here under the auspices of the P. E. N. Club. Another, the International Youth Rally at the Albert Hall, is due to take place next month. Taken together, these conferences are solid evidence of the new position which this country is rapidly assuming as a centre—one might almost say the centre—of leadership in international affairs, both political and cultural.

The British Association Conference, however, has an added significance in that it deals with science. Science is not truly science unless fully free. The necessary freedom of science is twofold—freedom from

internal interference and freedom for international interchange. Nazi Germany has systematically interfered with both these freedoms. The result, readily noticeable for some time before the war, was a deterioration in the quality of German scientific work, especially in fields of new and fundamental research. The Nazi régime, as the Foreign Secretary said yesterday, has effected its own intellectual encirclement. As a result it is now living on its scientific capital. This has important consequences, both for the war and for the subsequent peace. It is a remarkable fact that, in spite of the Nazis' intensive scientific preparations for war, this country has already surpassed Germany in many applications of science to war. The superiority of our aircraft and of our systems of aircraft detection is a matter of public record; and there are a number of other examples which must for the present remain as military secrets. The mobilization of the resources of a democracy behind the national effort may be slow, but is sure and cumulatively effective. This is especially true of our scientific resources. But just because we stand for freedom, in science as elsewhere, our efforts have been notably supplemented by aid from the United States. In the scientific sphere, as elsewhere, this aid is steadily increasing, and our

scientific achievements, thus powerfully reinforced, may well prove to be a factor of major military importance.

The conference which opens to-day [September 26] will deal primarily with post-war problems. Much lip-service is paid to the idea of planning, but it is not always realized that planning will be neither effective nor tolerable unless it is backed by science. Every planning authority, whether comprehensive like the Tennessee Valley Authority or devoted to some special function like the Rockefeller Institute's campaign against yellow fever in South America, needs its team of research workers and scientific advisers. It is a bare three years since the century-old British Association established its Division for the Social and International Relations of Science. This conference is a proof of the validity of the idea behind that decision. In Mr. Eden's words, "from henceforth science and statecraft must march together. Diplomacy, which has up till now been the servant of higher strategy, must increasingly become the servant of science." Science in its turn must increasingly become the servant not of war, or of big business, or of a particular régime, but of the general welfare of mankind.—*The London Times*.

## SCIENTIFIC BOOKS

### MAMMALIAN FAUNA

*The Mammalian Fauna of the White River Oligocene.* Trans. Amer. Phil. Soc., N.S., Vol. XXVIII. Part I: *Insectivora and Carnivora*, by W. B. SCOTT and G. L. JEPSEN, pp. 1-154, pl's I-XXII, 1936. Part II: *Rodentia*, by A. E. WOOD, pp. 155-270, pl's XXIII-XXXIII, 1937. Part III: *Lagomorpha*, by A. E. WOOD, pp. 271-362, pl's XXXIV-XXXV, 1940. Part IV: *Artiodactyla*, by W. B. SCOTT, pp. 363-746, pl's XXXVI-LXXXVIII, 1940. Part V: *Perissodactyla*, by W. B. SCOTT, pp. 747-980, pl's LXXIX-C [also contents and addenda for whole volume, pp. i-xvi]. 1941.

IN 1846 Dr. Hiram A. Prout, of St. Louis, received from a friend the fragmentary jaw of a gigantic extinct mammal, found in the "Mauvais Terre, on the White River." As years passed, this first specimen was followed by dozens, hundreds and thousands. The Mauvais Terre became the Big Badlands and badlands became a technical term for similar country all over the earth. The White River gave its name to a group of strata not only forming the Big Badlands of South Dakota but also underlying an enormous area beyond them, from Montana to Nebraska. The time represented by the deposits includes most of the Oligocene. The rich faunas have become a standard of comparison

for the world. No fossil deposits have been worked more intensively and more continuously during the last century. The rising flood of notes, papers, comments and special monographs has tended to obscure the broader and more significant features of these important faunas in a mass of detail, hard to find and hard to synthesize once found.

Already in 1869 the need for such a synthesis was felt and the White River faunas were the main basis for a great memoir by Joseph Leidy, a work of 472 quarto pages and 30 plates that became a monument in the history of paleontology. Eighteen families and 25 genera were then known from the White River Group. For two generations no one had the courage to face the great task of keeping the synthesis abreast of the rapid discoveries. Then in 1934 Professor Scott undertook "to fill out and complete the admirable sketch which Dr. Leidy gave to the world." The American Philosophical Society gave a grant and undertook to publish the results. An excellent artist, R. Bruce Horsfall, was employed, and Professor Scott set out on an ambulatory research program of the sort becoming more and more necessary but seldom so successfully arranged. Twelve museums, scattered from the Atlantic to the Rockies, were successively or repeatedly bases of operation. Every genus was

studied and illustrated by its best-known specimens, wherever these happened to be. Specialists in particular groups, Drs. G. L. Jepsen and A. E. Wood, collaborated. Now after more than seven years the project is completed and is before us for appraisal and for use.

Since Leidy, the number of families of mammals known from the White River has more than doubled (it is now 40) and the number of genera has more than quadrupled (now 101). This increase in breadth of knowledge is accompanied by comparable increase in depth. Leidy had fair skulls of a dozen genera but virtually no skeletal material. Now good skulls are known for almost all genera, including so many that Leidy did not know at all, and the complete skeleton is known for more than twenty. Bringing together a sufficient summary of all these discoveries would, in itself, make this monograph an outstanding success and one of the most useful of recent publications.

Even within the span of a thousand pages, rigid limitation is necessary with so large a subject. The plan of this monograph stresses the type morphology and the taxonomy of genera. Higher taxonomic categories are designated but not, as a rule, defined and only briefly discussed. Selected specimens are measured, but the descriptions are mainly on a qualitative generic level. As for species, Professor Scott recognizes that these "would be much the more important category . . . were the necessary information available," but the imperfections of present data are such that "the significant unit is rather the genus." Although there is much that is wholly new in this great volume, the point of view is that of bringing together and holding fast the most secure results of past and recent research. Species are listed and summarized on the basis of existing data and for completeness of record, but the authors repeatedly emphasize that many of these "species" are invalid and most of them are ill-defined. No serious attempt to revise them is made.

The super-specific classification is for the most part a happy expression of the most recent and best-informed opinions. This reviewer objects to a few points of nomenclature (such as Cynoidea, Oreodontidea, Hippoidea and some others as names for superfamilies), but such matters are nominal and of secondary importance. The major taxonomic novelty is placing the hypertraguloids and oreodonts in the Tylopoda, a return to Professor Scott's opinion of 1899, which had been generally rejected, even by its proposer. As regards the hypertraguloids, new evidence is adduced which does not quite settle the problem but which at least puts it on a new unsettled basis by showing that tylopod affinities can not be dismissed. Evidence bearing on the oreodonts is less explicit.

The crux of the whole matter lies before the White River, in the Eocene, as Professor Scott notes. With characteristic energy he has already begun a similar revision of the Uinta (late Eocene) faunas, and here this difficult taxonomic question may be more fully treated.

As regards the morphological sections, it suffices to say that they are up to Professor Scott's standard, in other words, they are excellent. Necessarily compendious, they are yet adequate for any ordinary purpose and do not sacrifice either style or accuracy to brevity. Few will need ever again to go back of this monograph to the scattered older literature. The few specialists who must still seek the sources will find here a powerful aid in their search, and in the comprehension of their problems.

No study of the White River fauna will ever be final, but it is probable that this remarkable monograph is definitive. It is unlikely that future discoveries will necessitate repetition of the particular task here completed, and the end of an era of White River studies is thus marked. As Professor Scott implies, however, this is at the same time the beginning of another era of study, one that will, as far as prediction is possible, be as long and laborious as all that has gone before. The general composition and character of the faunas, the major morphological characters of the included animals and the intermediate levels of their taxonomy are fairly in hand. All this basic information is gathered together in this work, a work classic in scope and style and clearly destined to become historically classic. Now the ground is cleared and the foundation laid for the paleontology of the future: detailed descriptive and functional morphology (for instance of the internal ear structures), the study of variation, of growth and of paleogenetics, the recognition of species as natural populations by group methods, the extension of taxonomic revision to higher and to lower levels, the paleoecological study of the extinct animal associations, the tracing of specific lineages and of larger populations through more exactly recorded time sequences, the integration of these still remote results with general evolutionary theory. It is the greatest tribute to this monograph and to its senior author that its value is not alone that of major research well completed but also that of a signpost and a stimulant for still more arduous work now barely begun.

GEORGE GAYLORD SIMPSON

THE AMERICAN MUSEUM OF  
NATURAL HISTORY

#### PHYSICS

*Vacuum Tube Voltmeters.* By JOHN F. RIDER.  
xi + 179 pp. New York: John F. Rider, Publisher,  
Inc. 1941. \$1.50.

As stated in the author's foreword, "This book on the Vacuum-Tube Voltmeter is intended as a practical exposition of the numerous types of such measuring devices, with the direct intention of providing a source of information for the engineer, student and serviceman, so that if he desires to compare different types, establish their principles of operation or construct them, all the facts are available from one source."

The book provides a very valuable contribution for the aforesaid purpose. It is simple in language and direct in attack, so that the instrument to be discussed is presented with the minimum of preamble. The book is practically free from mathematical equations, and in that sense is very elementary. Nevertheless, a certain amount of previous knowledge is necessary if the reader is to get the maximum of value from the work, since the significance of many of the features rests largely upon such knowledge. While the author has done what is reasonably possible within the wide scope of instruments discussed to point out pitfalls, and to state why certain situations must be avoided in certain cases, the subject of high frequency oscillations in particular is a field in which it is frequently necessary and always desirable for the investigator to have intimate knowledge of the characteristics of his circuits before assuming what will happen when any additional measuring device is incorporated with them.

While the book is intended in part for one who has no great knowledge of circuit theory, the present reviewer feels that one of its greatest uses will be for the investigator in physics who, while well equipped in a knowledge of handling circuits, is nevertheless unfamiliar with the special technical devices employed. Such a physicist will find in the book a wealth of information which may save him the labor of re-designing circuits for his special needs. He can pick

out what he wants, and his theoretical knowledge will then permit him to examine the instrument in all details relevant to his own particular problem.

The contents of the book may be gauged by the chapter titles, as follows:

- Chapter I. Fundamentals of Vacuum-Tube Voltmeters.
- Chapter II. Diode Vacuum-Tube Voltmeters.
- Chapter III. Triode Vacuum-Tube Voltmeters.
- Chapter IV. Slide-Back Vacuum-Tube Voltmeters.
- Chapter V. Rectifier-Amplifier Vacuum-Tube Voltmeters.
- Chapter VI. Tuned Vacuum-Tube Voltmeters.
- Chapter VII. Audio-Frequency and Logarithmic Vacuum-Tube Voltmeters.
- Chapter VIII. Vacuum-Tube Voltmeters for D-C Voltage, Current, and Resistance Measurements.
- Chapter IX. Design and Construction of Vacuum-Tube Voltmeters.
- Chapter X. Calibration and Testing of V-T Voltmeters.
- Chapter XI. Applications of V-T Voltmeters.

Chapters I-VIII inclusive each contains descriptions of several different types of instruments adapted to various needs, with a general review of the underlying principles. Chapter IX, as its name implies, contains a special discussion of the elements which demand consideration in order to produce an instrument which will record what it is intended to record. Chapter X deals with a variety of matters concerned with the necessity for and means of carrying out continual checks on the instruments, and Chapter XI contains several examples of typical fields for the use of the instruments.

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## REPORTS

### STATEMENT BY THE BOARD OF DIRECTORS OF THE AMERICAN CHEMICAL SOCIETY

BECAUSE of efforts to compel chemists and chemical engineers to join labor organizations in order to obtain or retain employment in certain plants, the board of directors of the American Chemical Society has given consideration to the broad problems of employment in the field of chemistry.

So that the position of the society may not be misunderstood, the board of directors issues the following statement for the more complete information of our membership:

The society has taken no stand against "collective bargaining" for professional men when such bargain-

ing is not controlled by non-professional groups and where the bargaining unit is composed exclusively of professional men.

The society condemns no one of its members for joining any non-coercive labor union so long as he does so voluntarily.

The society, however, is unalterably opposed to the forcible inclusion of professional men in bargaining units dominated and controlled by non-professional employees, whether that inclusion be brought about by economic pressure upon an employer, by intimidation of the professional employee or by operation of either state or federal law.

The society will bend every effort to maintain for all its members the "right to work" and the "right to

employment and promotion" on the basis of worth and merit.

Accordingly the board of directors goes on record as opposed to affiliation of its members with any organization that conditions promotion primarily on the basis of "seniority" or that insists that they join any labor organization where they would be in a minority, with no power to protect themselves while paying "protection" thereto as an essential to the privilege of earning a livelihood and with their wage scales negotiated by those whose selfish interest would require that benefits be sought for the larger number of non-professional workers to the detriment of the relatively few professional employees.

Letters from some members, supported by facts and intelligent argument, claiming that conditions during the depression and under the emergency have secured for tradesmen and laborers, under union leadership, advances in income not enjoyed by trained professional men often directly associated with the former have been given consideration.

Already a number of our more progressive employers have made surveys of their personnel and have taken, or propose to take, corrective measures.

In order that some logical conclusion may be reached, it seems wise to consider the distinction between professional and non-professional employees engaged in chemical work in order properly to differentiate between professional and non-professional workers.

At the present time there are a large number of technicians employed in the field of chemistry.

The term "technician" may be applied to routine workers, trained in the laboratory but with no special education or mental proficiency in chemistry and allied sciences. Normally they will be individuals with secondary school education only, or perhaps ones who have failed to acquire a baccalaureate degree through lack of funds, insufficient effort or capacity or attendance at under-equipped educational institutions. These are almost always paid wages on the hourly basis and are often included in labor union agreements. No proper objection can be raised to their inclusion in a bargaining unit composed of employees doing various kinds of skilled, semi-skilled or unskilled work.

The two groups of employees which should not be subjected to forcible inclusion in a heterogeneous bargaining unit are those who have received degrees in chemistry or chemical engineering and are engaged in these fields, either as chemical internes or as professionals.

The term "chemical interne" may be applied to those who are essentially in the final qualifying stage for their life work in the field of chemistry. They

have received their baccalaureate degrees with majors in chemistry or chemical engineering, have proved their proficiency not only in chemistry but also in mathematics, physics, modern languages, et cetera. They are acquiring thereby the necessary training and experience to qualify for full professional status or standing. Those in industrial corporations are engaged in professional work on problems confidential to management, whether their work be control, research or development.

The term "professional" should be applied only to those who have the baccalaureate degree or its equivalent by specific accomplishment, and who, having been graduated from institutions approved by the American Chemical Society, have had at least two years of postgraduate training in chemistry or chemical engineering in institutions of like grade or have for an equal period obtained experience in chemical work. For graduates of other educational institutions five years of postgraduate training and/or experience subsequent to the baccalaureate degree should be required. These are the minimum requirements for full professional membership in the American Chemical Society.

The board of directors has heretofore hesitated to make any suggestions on the matter of adequate compensation. On the whole our educational institutions and chemical corporations have realized the value of brains and have compensated employees accordingly. The chemical profession as a whole is on a level with any other profession in material return. There are to-day in our profession, as in many others, individuals whose compensation is high, indeed almost fabulous, and others who are grossly underpaid. There are many who, even in the higher brackets, earn more than their income. There are some, even in the lower brackets, who are not worth their hire, and who should, for their own sakes and for the reputation of the profession, seek other more fitting fields for a livelihood.

In spite of this generalization there has come to the attention of the board of directors evidence that there are to-day many cases where worthy professional men with years of study and training are grossly underpaid and are receiving less compensation than men without any specialized education employed in many of the trades and crafts.

In the opinion of the board of directors, the time has arrived when it must publicly suggest to all employers of chemists and chemical engineers that they review with care their employer-employee relations in this line of endeavor. The American Chemical Society stands ready through a carefully chosen committee on economic status to act in an advisory capacity both to employers and to employee groups of

its members and, if deemed helpful, to publicize its findings. Enlightened management will, it is believed, welcome consultation with such a committee composed of carefully chosen individuals.

As a beginning, the board of directors suggests that all worthy chemical internes and professionals when engaged in professional work be paid on a salary and not on an hourly basis.

The extent of training, experience and capacity, as well as individual personality and merit, are factors that must be considered when employing one to engage in professional work. Bearing these factors in mind, as well as the objects of this society, and the requirements for membership therein, the board ventures to make the following suggestions to employers for their consideration in respect of starting salaries for chemical internes and professionals under present economic conditions, when such persons are employed to do professional work:

A minimum starting salary not less than \$1,500 per annum for any chemical interne; and one of not less than \$1,800 per annum for any chemical interne of better than average ability or training, including especially those graduated from institutions whose chemical work is of particularly high quality such as those approved by the American Chemical Society; and a minimum starting salary of not less than \$2,400

per annum for any individual who has attained "professional" grade as hereinbefore described and, according to the extent of training and capacity, higher starting salary in proportion to training, experience, merit and individual accomplishment.

The foregoing suggestions are for minimum starting salaries only and are not to be regarded as suggestions for maximum salaries or as recommendations for a wage scale. They are made in respect of only those who are engaged for professional work in the field of chemistry and chemical engineering, as the society can not concern itself with problems of employment in other fields.

Inasmuch as technicians normally come under non-professional status, the technician grade does not come within the purview of this organization.

The board of directors recommends to employer and employe alike personal contact and careful consideration before concluding financial arrangements. Also it respectfully reminds both employers and members of this organization that the Employment Clearing House held at the semi-annual meetings of the society affords special facilities for consultation.

The committee on economic status will give its immediate consideration to the whole question of employment in professional work in the field of chemistry.

## SPECIAL ARTICLES

### P-AMINO BENZOIC ACID PREVENTS THE GROWTH-INHIBITORY ACTION OF SULFANILAMIDE<sup>1</sup>

Woods<sup>2</sup> discovered that p-aminobenzoic acid counteracts the inhibitory effect of sulfanilamide on the multiplication of bacteria in suspensions. He obtained this effect not only with commercially prepared p-aminobenzoic acid, but also with a substance, extracted from yeast, which appeared to be chemically identical with the acid.

Woods's results have been confirmed by the work of Landy and Wyeno,<sup>3</sup> who found that the bacteriostatic effect *in vitro* of sulfanilamide, sulfapyridine and sulfathiazole on streptococci, pneumococci and staphylococci, respectively, was completely neutralized by p-aminobenzoic acid. The extraction of p-amino-benzoic acid from yeast has been confirmed by Rubbo and Gillespie.<sup>4</sup>

<sup>1</sup> From the Laboratory of Surgery of the Yale University School of Medicine, New Haven, Connecticut. The experiments were aided by funds granted to Dr. K. W. Thompson by the John and Mary Markle Foundation and by the Yale University School of Medicine from the Clinical Research Funds.

<sup>2</sup> D. D. Woods, *Brit. Jour. Exp. Path.*, 21: 74-90, April, 1940.

The present report will serve to record the application of Woods's findings to the action of sulfanilamide and p-aminobenzoic acid on a dermatophyte.

#### METHODS AND MATERIALS

A strain of the fungus, *Trichophyton purpureum* (Bang), was secured from fragments of skin of a patient suffering from dermatomycosis. The organism was cultivated on honey-peptone agar slants for approximately two months, at the end of which time spores were abundant and the mat fairly friable. From this culture a suspension for inoculation was prepared by adding 10 cc of sterile physiological saline solution to the slant, breaking up the mat with a sterile needle and agitating the suspension. The latter was then centrifuged and washed three times, and the final precipitate resuspended in 10 cc of saline solution. The standard inoculum for each Petri dish consisted of one loopful of this suspension.

The spore suspension was inoculated on sterile agar plates, which were incubated at 28° C. in order to obtain optimum growth. The growth-rate of the cul-

<sup>3</sup> M. Landy and J. Wyeno, *Proc. Soc. Exp. Biol. and Med.*, 46: 59-62, January, 1941.

<sup>4</sup> S. D. Rubbo and J. M. Gillespie, *Nature*, 146: 838-9, December, 1940.

tures was estimated in terms of colony diameter; two diameters of each colony were measured at approximately 3-day intervals for three weeks.

The agar medium in each case was a balanced stock base having the following composition: distilled water, 1,000 cc, dextrose, 20 g,  $\text{MgSO}_4$ , 0.5 g,  $\text{KH}_2\text{PO}_4$ , 1 g, KCl, 0.5 g,  $\text{FeSO}_4$ , 7  $\text{H}_2\text{O}$ , .01 g, agar, 15 g. To each liter of medium was added 2 grams of a nitrogen source. The salts  $\text{NaNO}_3$  and  $(\text{NH}_4)_2\text{SO}_4$ , the amino acid asparagine and the protein egg albumin served as nitrogen sources. Peptone was not used as a source of nitrogen, since it masks the effect of sulfanilamide. This fact was ascertained by preliminary experiments, thus confirming for the test-fungus the results obtained by Lockwood for bacteria.<sup>5</sup>

Each Petri dish was prepared in such a way that when the nutrient agar was added there was the appropriate amount of sulfanilamide (1:1,000), or p-aminobenzoic acid (1:5,000, 1:10,000, 1:50,000, 1:100,000, 1:500,000) or both. Control plates contained only the nutrient agar.

#### EXPERIMENTAL RESULTS AND DISCUSSION

The addition of sulfanilamide in 1:1,000 concentration to any of the above-mentioned media caused complete inhibition of mat growth, although germination of spores occurred. This inhibition was entirely nullified by the addition of p-aminobenzoic acid in concentrations as low as 1:500,000. However, addition of the acid alone to the culture media had no effect in increasing the rate of growth.

Differences in source of nitrogen brought about slight changes in the basic growth-rate, but did not materially alter the inhibiting effect of the sulfanilamide nor the antagonistic effect of the acid.

These results agree with those obtained by Woods for bacteria; in both cases the p-aminobenzoic acid exerts a striking interference with the inhibitory action of sulfanilamide. Woods has offered the suggestion that p-aminobenzoic acid is a substance, occurring naturally in yeasts, which acts as a co-enzyme in a phase of bacterial metabolism and is therefore an essential growth-substance for bacteria.<sup>6</sup> He further suggests that sulfanilamide, because of its structural similarity to the acid, is able to substitute for the latter in the enzyme reaction and thus interfere with normal metabolism. Only by the addition of an excess of the acid can the inhibitory effect of sulfanilamide be overcome. The fact that relatively small quantities of the acid are able to counteract the effect of the

sulfanilamide appears to indicate a preference on the part of the organism for the acid. Although the experiments herein reported do not in themselves confirm such a hypothesis, they do give added evidence for its plausibility.

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#### THE INHIBITION OF BRAIN OXIDATIONS BY A CONVULSANT BARBITURATE

QUASTEL and his collaborators<sup>1</sup> hold the view that narcosis is essentially an inhibition of brain glucose oxidation. They have shown that barbiturates, as well as other narcotics, depress the *in vitro* oxidation of glucose, pyruvate and lactate by brain slices, apparently by inhibition of dehydrogenases.<sup>2</sup> They believe that this inhibition occurs with concentrations which are of the same magnitude as those which produce anesthesia *in vivo*. The oxidations of yeast, and the oxidation by brain of succinate, p-phenylenediamine and  $\alpha$ -glycerophosphate remain uninhibited by the same concentration. Thus they differentiate narcotics from tissue poisons which inhibit oxidations in general.

Sodium 1,3-dimethyl-butyl-ethyl barbiturate<sup>3</sup> has recently been synthesized and studied by Swanson and Chen.<sup>4</sup> It differs chemically from sodium pentobarbital only in the 3-methyl substitution on the butyl side chain, but in contrast to the depressant action of pentobarbital, this compound produces convulsions in warm-blooded animals. In view of the inhibitory effect of pentobarbital on glucose oxidation by brain slices it seemed possible to use this closely related compound, with its strikingly aberrant action in the intact animal, to test this theory of narcosis.

The oxygen consumption was measured by the direct method of Warburg, using 1.9 cc of Kreb's phosphate-saline, pH 7.2 at 38° C. Fifty to 100 mgms wet weight of freshly sliced whole rat brain were used. The barbiturate was dissolved in the same medium, and added from the side arm of the vessel after allowing a preliminary period for determination of the normal respiratory rate of the tissue. Control vessels were run in all cases. To eliminate the possibility that this compound is a tissue poison in the concentrations used, its effect on yeast oxidation was tested by the same method. No inhibitory effect was observed in a concentration of 50 mgm per cent.

<sup>1</sup> J. H. Quastel and A. H. M. Wheatley, *Proc. Roy. Soc. London*, B 112: 60, 1932; M. Jowett, *Jour. Physiol.*, 92: 322, 1938; J. H. Quastel, *Physiol. Rev.*, 19: 135, 1939.

<sup>2</sup> D. R. Davies and J. H. Quastel, *Biochem. Jour.*, 26: 1672, 1932.

<sup>3</sup> We wish to thank Dr. E. E. Swanson of the Lilly Research Laboratory for kindly supplying this compound.

<sup>4</sup> E. E. Swanson and K. K. Chen, *Quart. Jour. Pharm. and Pharmacol.*, 12: 653, 1939.

<sup>5</sup> J. S. Lockwood, *Jour. Immunol.*, 35: 155-190, September, 1938.

<sup>6</sup> S. Ansbacher has recently found the acid to be a growth-promoting factor for the chick, and believes it to be one of the factors of the vitamin B complex. *SCIENCE*, 93: 164-5, 1941.

TABLE I

THE EFFECT OF SODIUM 1,3-DIMETHYL-BUTYL-ETHYL BARBITURATE ON RAT BRAIN SLICE RESPIRATION

Final barbiturate concentration	Substrate	Number of experi- ments	Average per cent. 0-60 Min.	Inhibition of $QO_2$ 60-120 Min.
Mgm per cent.	200 mgm per cent.			
0.1	Glucose	3	+ 3	6
1.0	"	5	- 7	- 6
5.0	"	2	- 17	- 19
10.0	"	6	- 16	- 25
50.0	"	6	- 43	- 77
10.0	Succinate	2	- 7	- 3
50.0	"	2	+ 3	- 2

From the results given in Table I it is apparent that sodium 1,3-dimethyl-butyl-ethyl barbiturate is effective in producing inhibition of glucose oxidation of rat brain slices. Assuming equal distribution of the drug, calculations from data of Swanson and Chen,<sup>3</sup> on the rat, establish approximate tissue concentrations of 1 and 2 mgm per cent. for convulsive and lethal doses, respectively. A comparable inhibition of rat brain oxidation is observed with equivalent concentrations of sodium pentobarbital, but when administered to the intact animal in doses equivalent to those of the aberrant barbiturate it produces depression. These results are not explained by Quastel's theory of anesthesia.

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#### INDICATIONS OF AN INCREASE IN NUMBER OF C-ATOMS IN ACIDS AND NUMBER OF ACIDS IN SEED FATS WITH ADVANCE IN EVOLUTION- ARY POSITION

In the latest compilation of analyses of seed fats,<sup>1</sup> data from 16 natural orders (Engler and Prantl classification) are given. When the component acids of the families of these orders are considered it is found that 7 orders have an increase in the number of acids, 8 have an equal number of acids and one has a decrease in the number of acids with an advance in evolutionary position of their constituent families.

When the number of carbon atoms of these acids is considered it is found that 8 orders have an increase in the number of C-atoms, 6 have equal number of C-atoms and 2 have a decrease in the number of C-atoms with an advance in evolutionary position. If, however, the terminal families of those analyzed of the Malvales, Myrtiflorae, Contortae and Tubiflorae (i.e., respectively, Sterculiaceae, Myrtaceae, Ascle-

piadaceae and Acanthaceae) be removed from consideration, then 3 of these 4 orders show an increase in the number of acids and all 4 show an increase in the number of C-atoms in these acids with an increase in evolution. An increase in the number of C-atoms indicates in these instances an increase in molecular weight of the acids which contain them.

The data may be summarized as follows: *Fagales*—Betulaceae Number of C-atoms 14-16-18, number of acids 5; Fagaceae 16-18-24, acids 6: *Urticales*—Ulmaceae, 10-12, acids 2; Moraceae 18, acids 3: *Santalales*—Santalaceae 16-18, acids 2; Olacaceae 16-18-20-26, acids 8: *Ranales*—Berberidaceae 16-18, acids 4; Menispermaceae 16-18-20, acids 6; Magnoliaceae 16-18, acids 4; Anonaceae 16-18-24, acids 6; Myristicaceae 10-12-14-16-18, acids 8; Lauraceae 10-12-14-16-18, acids 6: *Rhoadales*—Papaveraceae 14-16-18-20, acids 9; Cruciferae 16-18-20-22-24, acids 9: *Rosales*—Rosaceae 14-16-18-20, acids 10; Leguminosae 14-16-18-20-22-24, acids 9+: *Geraniales*—Tropaeolaceae 16-18-22, acids 5; Linaceae 14-16-18-20, acids 7; Rutaceae 16-18-24, acids 6; Simarubaceae 10-12-14-16-18, acids 10; Burseraceae 16-18-20, acids 5; Meliaceae 14-16-18-20, acids 7; Vochysiaceae 12-14-16-18, acids 5+; Euphorbiaceae 14-16-18-20, acids 10: *Sapindales*—Buxaceae 18-20, acids 3; Anacardiaceae 14-16-18-20, acids 6; Celastraceae 16-18, acids 6; Salvadoraceae 8-10-12-14-16-18, acids 7; Staphyleaceae 16-18, acids 4; Hippocastanaceae 16-18, acids 5; Sapindaceae 10-12-14-16-18-20-22-24, acids 11: *Rhamnales*—Rhamnaceae 16-18, acids 5; Vitaceae 16-18-20-22, acids 8: *Malvales*—Tiliaceae 16-18, acids 4; Malvaceae 14-16-18-20, acids 7; Bombacaceae 14-16-18-20-24, acids 7; Sterculiaceae 16-18, acids 4: *Parietales*—Caryocaraceae 14-16-18, acids 5; Theaceae 14-16-18-20, acids 6; Guttiferae 14-16-18-20-22, acids 7; Dipterocarpaceae 14-16-18-20, acids 6; Flacourtiaceae 16-18, acids 7; Passifloraceae 16-18-20-26, acids 8; Caricaceae 16-18-20, acids 5: *Myrtiflorae*—Elaeagnaceae 16-18, acids 5; Lecythidaceae 14-16-18, acids 5; Combretaceae 14-16-18-20, acids 6; Myrtaceae 16-18, acids 5: *Umbelliflorae*—Araliaceae 16-18, acids 4; Umbelliferae 16-18, acids 4: *Contortae*—Oleaceae 16-18, acids 4; Apocynaceae 16-18-20-24, acids 7; Asclepiadaceae 16-18, acids 4: *Tubiflorae*—Convolvulaceae 16-18, acids 5; Verbenaceae 16-18, acids 4; Labiatae 18, acids 3; Solanaceae 14-16-18-20, acids 6; Scrophulariaceae 16-18, acids 5; Pedaliaceae 16-18-20, acids 5; Acanthaceae 14-16-18, acids 6: *Rubiales*—Rubiaceae 10-14-16-18-20, acids 7; Caprifoliaceae 16-18-20, acids 6; Valerianaceae 16-18, acids 5; Dipsacaceae 16-18, acids 4.

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<sup>1</sup> T. P. Hilditch, "The Chemical Constitution of Natural Fats," John Wiley and Sons, 1940.

# SCIENTIFIC APPARATUS AND LABORATORY METHODS

## AN APPARATUS FOR THE DETERMINATION OF THE SOLUBILITIES OF GASES AT HIGH TEMPERATURES AND HIGH PRESSURES

The apparatus consists of a modified Ipatieff rotating bomb and a sampling arrangement separating the dissolved gas from the solvent in samples withdrawn from the bomb.

The rotating bomb (Fig. 1) is provided with two

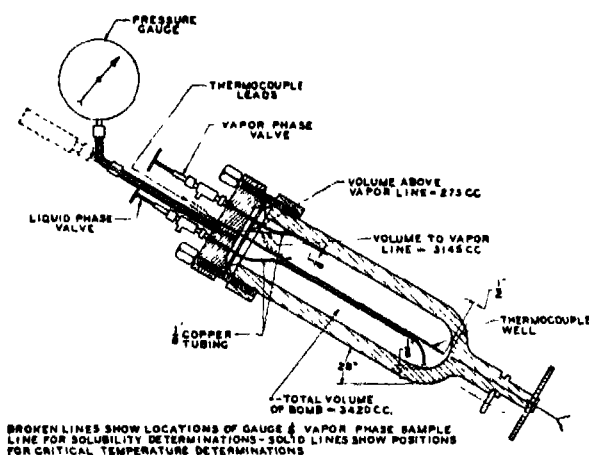


FIG. 1

needle valves attached to sampling lines, the shorter terminating just below the head of the bomb and the longer reaching the lower end or bottom of the bomb, making it possible to remove vapor phase and liquid phase samples when the bomb is operated at an angle of 20–30 degrees with the horizontal.

The sampling arrangement (Fig. 2) consists of a

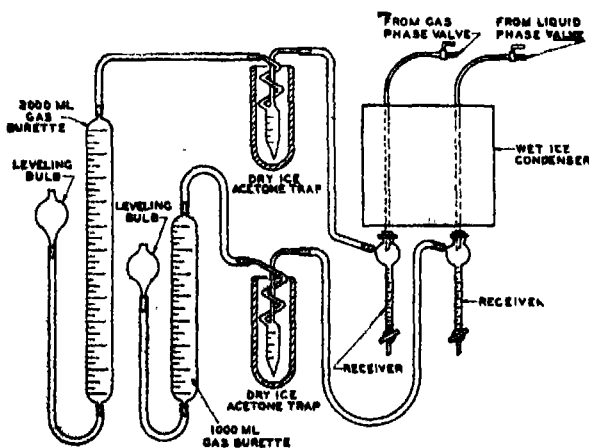


FIG. 2

wet ice condenser with receiver, trap and a gas burette of 1,000 cc capacity for liquid phase samples and a

similar device for vapor phase samples but with a gas burette of 2,000 cc capacity. The traps are immersed in a cooling bath at a temperature sufficiently low to condense the solvent escaping condensation in the wet ice receiver but allowing the gas to collect as such in the gas burettes when the samples are released to atmospheric pressure through the needle valves on the bomb head. The gas is collected over saturated sodium chloride solution.

A similar but smaller apparatus is used for purging the draw-off lines before the main samples are taken.

In making solubility determinations the bomb is charged with solvent to about one half its total capacity (3,420 cc). The gas is then charged at room temperature, the initial pressure depending on the temperature and pressure range of the solubilities to be determined. The bomb is set in rotation and heated to the desired temperature level. The rotation is stopped after one half hour, sample lines purged, the vapor phase sample (700–1,000 cc gas) and the liquid phase sample (7–9 cc condensate) taken. When the composition of the vapor phase and liquid phase samples differ, a two-phase condition exists in the bomb and the solubility can be calculated from the composition of the liquid phase sample. When the composition of the two samples is the same a one-phase condition prevails and no solubility of gas in liquid as such exists.

If the bomb is charged at different initial pressures, *e.g.*, 10, 25, 50, 75 atms., and solubilities determined at various temperatures for each initial pressure, curves may be drawn plotting temperatures and corresponding pressures *vs.* solubilities. Isotherm or isobar curves may then be derived.

In the determination of critical temperatures, the bomb is charged with the material investigated, the charge may vary from 20 to 50 per cent. of the capacity of the bomb. The bomb is set in rotation and the temperature raised about 1° C. per minute, taking the pressure and temperature readings at not greater than five minute intervals. The pressure *vs.* temperature is plotted on uniform scale. The pressure-temperature curve will show a "break" or point of discontinuity which will be within  $\pm 2^\circ$  C. of the critical temperature of the material, as determined by the usual methods.

In case of pure substances the existence of a two-phase condition below the break and a one-phase state above the break may be confirmed by running the pressure-temperature curve in the presence of hydrogen (initial pressure < 10 atms.) and comparing the compositions of samples taken from the vapor phase and liquid phase sample lines, the presence of hydro-

gen in the amount given above not affecting the break on the pressure-temperature curve to any noticeable amount.

The critical temperatures of two-component systems may be determined by the same procedure.

This apparatus can be used for other studies such as the investigation of equilibria in heterogeneous systems.

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### A SAFETY SWITCH FOR WATER-COOLED X-RAY TUBES

SINCE water-cooled x-ray tubes may be damaged if the flow of water is interrupted during operation, it is a common practice in physics laboratories to insert in the control circuits of x-ray machines so-called bucket switches which are held closed by the weight of the water that leaves the cooling system of the tube but which open automatically if for any reason this flow ceases. Such switches are satisfactory where the waste water can be dumped into a sink and where bulk is not a disadvantage. However, because they take up considerable space and can not be connected into a closed water system, it may be inconvenient or impossible to employ bucket switches in connection with medical x-ray apparatus.

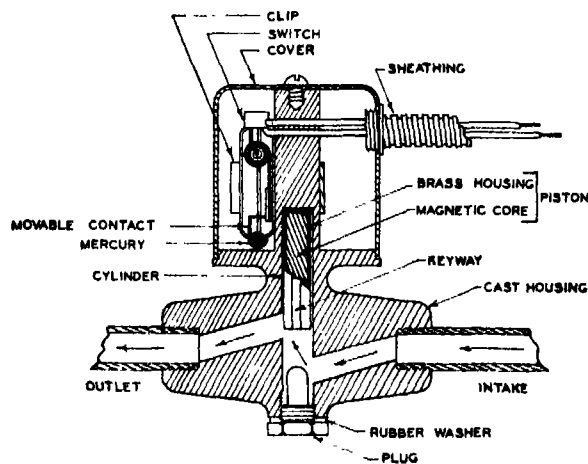


FIG. 1. Flow switch.

There is described here a simple, small, dependable flow switch which can be connected into a closed water-cooling system. The switch is normally open, closing when water flows through it and opening again when the flow stops, either because of pressure failure or a clogged waste line. The switch itself (a commercial product, Mercoid Magnetic Switch, No. 9-81R) consists of a glass capsule containing a pool of mer-

cury and two electrodes. One electrode is permanently bathed in the mercury; the second is held away by means of a coil spring but makes contact with the mercury whenever a permanent magnet is brought up to the side of the capsule.

The mercury switch is mounted against the outside of a vertical brass cylinder within which lies a piston made up of a brass housing surrounding a magnetic core. The fit between piston and cylinder is purposely loose and to further facilitate leakage between the two a longitudinal keyway is cut in the piston.

The magnetic core of the piston consists of a cylindrical, cobalt-alloy steel, permanent magnet having a diameter of approximately 9 mm, a length of approximately 3 cm (one third of a commercial cylindrical magnet, Central Scientific Company of Chicago, No. 78295-B).

**Operation:** When no water is flowing through the switch, the piston under the action of gravity moves down until it strikes a mechanical stop, in which position direct communication between intake and outlet ports is cut off and the magnet is below the level at which it will operate the magnetic switch. The latter, therefore, is open and the x-ray machine can not be operated.

When water flows through the device, the piston moves upward until a free communication is established between intake port and outlet port in which position the armature of the magnetic switch is attracted, the second electrode makes contact with the mercury, the control circuit of the x-ray machine is completed and the x-ray tube can be operated.

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- A.S.T.M. *Standards on Petroleum Products and Lubricants, 1941; Methods of Testing, Specifications, Definitions, Charts and Tables.* Pp. viii + 398. Illustrated. American Society for Testing Materials, Philadelphia. \$2.00.
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## FUTURE SOURCES OF POWER<sup>1</sup>

By Professor C. C. FURNAS

YALE UNIVERSITY

THE sun's rays shower as much energy on the earth's surface in one minute as the entire human race utilizes in one year. Despite the presence of this bountiful and unusual flow of energy, a large part of the struggles of the human race are concerned with acquiring and controlling sources of power. Evidently our state of development in the utilization of power is still rather crude. A review of the various practical sources of the present day is in order.

### PETROLEUM

The energy supply which is most critical in America is that of petroleum. At the present time we are

using considerably over a billion barrels per year. The known proved reserve of petroleum in the ground is 14 to 17 billion barrels, depending on who does the estimating. Thus the petroleum actually in sight is only about a twelve-year supply. But new discoveries are being made constantly so most of the people in the petroleum industry say they are not worried about the supply, at least for the present generation. It is a little discouraging to note, however, that the new discoveries are not quite keeping pace with use so the pinch of partial depletion may come sooner than the optimists anticipate.

There may be discoveries of great new fields, but the prospects of that are not very good. There is the possibility of extensive fields lying under the ocean

<sup>1</sup> Summary of an address before a joint meeting of the Rochester, Syracuse and Cornell sections of the American Chemical Society, Rochester, N. Y., October 4, 1941.

next to coastal plains such as border the Gulf of Mexico. There may also be a great deal of petroleum at far greater depths than are yet explored. We live in hopes that there are, but it should be remembered that if recovery is made from the more difficult places, the cost of production is certain to rise and the customer must pay for it.

Technical advances in refining have greatly extended the potential life of the petroleum resources. The wide-spread utilization of cracking has more than doubled the yield of gasoline and hence has more than doubled the potential supply of motor fuel. Now the polymerization of refinery gases into liquid fuels is beginning to come in and is helping to extend the life line of petroleum. Such technical advances are a great factor in keeping up the liquid fuel supply, but eventually, perhaps distressingly soon, the pinch of depletion will begin to make itself felt. What then? There are several possibilities that need to be evaluated.

I. *Getting all the petroleum out of the ground.* Even with the best production methods, over half the original petroleum deposit still stays in the ground after the well has gone dry. Mining of the sands seems to be impractical, not to mention being very expensive. If some one will devise an inexpensive means of breaking the adsorptive forces between petroleum layers and the sand grains, he will greatly lengthen the life of our oil resources, not to mention the possibility of making himself rich.

II. *Shale oil.* There are many billions of tons of oil shale in this country which when heated will yield from half a barrel to two or three barrels of petroleum-like oil per ton of shale. The potential supply is enough to supply our motor fuel for from 100 to several hundred years, depending on the grade of shale considered acceptable. But mining or quarrying the shale, retorting it and disposing of the waste costs effort and money. If the refinery cost of gasoline should double above its present figure of 5 to 6 cents per gallon then shale oil might begin to compete. Thus we have a considerable back log of motor fuel, but we will only get it by paying higher prices than at present.

III. *Hydrogenation of Coal.* Germany and, to a certain extent, England are making fairly satisfactory liquid fuels by reacting hydrogen gas with low-grade coal at high temperature and pressure in the presence of a catalyst. But the cost of production is about 20 cents a gallon compared to the American cost of 5 to 6 cents a gallon from petroleum. That high cost might be lowered somewhat, but the prospects are that it will not go down materially. Thus we can drive our cars on motor fuel from coal, but we'll have to pay dearly for it.

IV. *Alcohols from Agricultural products.* This is great fuel for politicians from the corn belt but not so practical for automobiles. The first item is cost—15 to 20 cents a gallon under best practice; next, lack of supply—a small fraction of our fuel might be supplied from waste and surplus farm products, but it would require nearly all the good crop land in the country to supply our motor fuel demand by this means. There wouldn't be anything left to eat.

Summarizing liquid fuels: We can have fuel for automobiles for at least several generations but at a price. The lush days of practically free oil from the ground will begin to end some of these days—probably too soon to please us. This generation may very well feel the pinch of partial depletion. Any economy or conservation steps are very much in order.

V. *Duplication of Geochemical Reactions.* Dr. Ernst Berl at the Carnegie Institute of Technology has succeeded in making liquid and solid fuels which are close duplicates of our petroleum and coal, using natural carbohydrates such as sugar as the starting material. He has apparently duplicated and greatly accelerated the geochemical reactions which produced these fuels. If we are to supply part of our fuel demands from current vegetation, Dr. Berl's work may be the best starting point.

#### COAL

In coal we are the most happily situated country in the world. We have over half of the world's known coal reserves; less than 6 per cent. of the world's population. At the present time we have enough coal in sight (all grades) to last 3,000 years. That picture may change if the other 94 per cent. of the people of the world decide that we must divide up, but that is one of the unpredictables. Hence as regards coal we may say that we are very lucky. But that doesn't mean we should be negligent of conservation. Within the next hundred years many of the best deposits will be depleted. We will have to begin depending on the lower grades. Expenses of recovery will go up, quality will go down. It will be wise to extend the life of our A-1 deposits as long as possible.

Eventually, no matter how much we conserve, this sponging off past ages for fossil energy must cease—the deposits will have gone up in smoke. What then? That's a question which America will face eventually, which many groups of people in the world are facing right now. Other possible sources of energy certainly should be considered.

#### OTHER SOURCES OF POWER

I. *Water power.* The water power sources of the world are by no means fully developed, but even if they were they would be quite inadequate. About 10

per cent. of America's energy comes from water power. By full development that could be extended to 20 or 25 per cent. It helps, but it simply is not enough.

II. *Wind.* Lots of energy goes to waste in a hurricane or tornado, but you can't count on it. The winds are not dependable even in Kansas. Moreover, the average breeze is at a very low potential as far as energy is concerned. Except for isolated, special cases where a high-cost storage capacity can be provided, wind power seems to be out.

III. *Tides.* In a limited number of places, such as ill-famed Passamaquoddy Bay, the use of tidal power may be practicable if a possible market is close at hand. Like the power from falling water, this may help, but it can supply only a small proportion.

IV. *Wave power.* Many wave motors have been designed; some of them have been patented. But the item of variability of the source of power seems to relegate this device to the impractical heap.

V. *Utilization of current vegetation.* About fifty times as much energy is stored up in plant life on the earth in one year as man utilizes in that year. It might then appear that we could use the present growing trees, grasses and shrubs for fuel and then solve the problem. Close investigation makes that idea discouraging. In the United States we would have to use nearly all our annual crop of vegetation (trees, grass, farm crops) to meet the energy demand. Nothing would be left to eat, and the land would all be a desert in a few years. We can't push vegetation very far from its natural cycle. All the data shows that we can not go back to a tree- and brush-burning economy.

VI. *Atomic energy.* The business of smashing atoms to release great gusts of energy is a profitable sport—for news reporters. Radioactive materials, of which there are only minute amounts in the earth, disintegrate and slowly release large amounts of energy. If radium, for instance, were as plentiful as copper, atomic boilers using radium as fuel might be practical, but there just isn't very much radium available. Recent work has shown that one of the isotopes of uranium,  $U_{235}$ , upon bombardment with slow neutrons, will disintegrate to give a net yield of energy equivalent to the burning of 3,000,000 times the same weight of coal. But separation of this isotope,  $U_{235}$ , has not yet been accomplished except in sub-microscopic quantities. Any other materials tried have not thus far shown any hopes for energy production. Thus any Atomic Energy Development Company seems to be facing a stone wall of discouraging facts. One can not arbitrarily say that we will never be able to get energy from atomic disintegration, but in our present forecasting we will be on safer ground if we don't count on it.

## DIRECT UTILIZATION OF SOLAR RADIATION

This brief survey has not answered the question of where we will get our energy, but it has pretty well covered the possible sources—excepting one—the direct utilization of the energy of the sun's rays.

The average intensity of solar energy in this latitude amounts to about 0.1 of a horse power per square foot. The energy falling on one square yard of roof would more than operate all the electrical household appliances, including lights, of the average family—if it could be directly utilized. Most factories have energy falling on the roof to operate all the machinery in the place—if the management had enough ingenuity to utilize it. No one has developed that ingenuity yet.

*Photoelectric Cells.* One of the obvious possibilities for direct utilization of solar energy lies in photoelectric cells. Thus far photoelectric cells have operated with microscopic efficiency and have been very expensive. If some one can make revolutionary improvements in photoelectric cell efficiency and can cut the cost of construction away down we might have something there. At present the prospects are discouraging, but one hesitates to say such utilization is forever impossible. Even with the items of efficiency and cost brought under control, the matter of storage of energy during periods of darkness would be troublesome. Large storage reservoirs of water might solve this problem, pumping water to high levels in daylight hours, using it in water turbines during darkness. The overall efficiency of such storage can be about 70 per cent. In general, it may be said that photoelectric cells are barely possible but not hopeful.

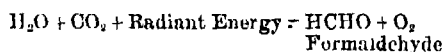
*Solar Boilers.* The simple and obvious device of using focussed sun's rays to heat up a liquid has been toyed with for a long time. Solar-boilers of various degrees of impracticality have been the child of many inventors' minds and the subject of many patents. Dr. Abbot, of the Smithsonian Institution, has a small solar power plant with revolving parabolic mirrors for which he claims an electrical energy production efficiency of 15 per cent. We'll have to do better than that if the sun's rays, which are not at very high intensity to begin with, are to be a practical source. It is not likely that the efficiency of the solar power plant, if it operates by steam generation, can be greatly improved.

On the other hand, solar energy may very well be on the verge of being practical for heating of buildings where a high potential is not important. The storage capacity must be sufficient for weeks or even months of operation. A basement full of hot water, periodically reheated by sun's rays, might be possible, but it hardly sounds practical. I would think that a closed cycle of employing a low-boiling liquid might better serve for such storage. First costs would be

high, but operating costs might be cut to the vanishing point.

Such an idea may bring a smile, but it is now becoming almost respectable, for the Massachusetts Institute of Technology has begun some experimentation along this line.

*Photochemical Reactions.* The foregoing suggest some interesting ideas, but with the exception of heating buildings, they do not seem to come within a gunshot of practicality. I have saved what I consider to be the best idea until the last. Namely, men should try to do efficiently what nature has been doing inefficiently for a billion years—utilize photochemical reactions. The basis of all life is some simple photochemical reaction as



The formaldehyde may be thought of as forming simple sugars, which then serve as the basic material for the multitude of complex compounds in plants. I realize that the actual photochemical reaction is much more complicated than this and that the formaldehyde theory is no longer tenable, but I am using this as the simplest picture to illustrate the point. What we should like to do would be to take some such simple compound as formaldehyde formed with the help of radiant energy, put it in an electrochemical cell, expose it to oxygen, and then reverse the above reaction and get back the stored energy as electrical energy—at high efficiency. Formaldehyde *can* be oxidized in a cell in a basic solution to give formic acid and a small amount of electrical energy. Perhaps all that is needed is a proper catalyst to complete the oxidation to  $\text{CO}_2$  and water and get back nearly all the stored energy.

The catalyst which nature used for performing the photosynthesis of the above equation is chlorophyll.

That's the best catalyst known, but it's very poor. Plants are very inefficient storers of energy. Even the most luxuriant plants have an energy storage efficiency of less than 2 per cent. We ought to be able to do a lot better than that.

It's a wide-open field, this study of photosynthesis and the study of oxidation cells which will reverse the reaction. That's the reason it's hopeful. The systems which might be used would not have to be limited to organic compounds. It may well be that inorganic compounds offer the most hope. The satisfactory system would need to be one that is as light-sensitive as the chemicals on a photographic film, as easily reversible as a lead storage cell. If such a photochemical-electrical system can be developed the problem of energy capture and storage would be solved. The storage of the energy would be simply that of storing chemical compounds. We're used to doing that with coal.

#### CONCLUSION

Some day the photochemical approach to energy utilization will either be solved or definitely proved impracticable. In view of our own energy resources it may seem foolish to start working on it now. But it may not be too early to start. If we wait too long we may be caught short as energy supplies dwindle. Moreover, many parts of the world already suffer from insufficient energy. Many international problems might disappear if every group of people could fully utilize the energy falling on its roof-tops.

Enough energy falls on about 200 square miles of an arid region like the Mohave Desert to supply the United States. When we become ingenious enough to efficiently utilize the energy treasure wherever it may fall, we may solve many of our economic problems. It might be a little hard on the railroads that haul coal, but every one else would benefit.

## A PRACTICAL SYSTEM OF UNITS FOR THE DESCRIPTION OF THE HEAT EXCHANGE OF MAN WITH HIS ENVIRONMENT

By Drs. A. P. GAGGE, Yale University; A. C. BURTON, University of Toronto, and  
H. C. BAZETT, University of Pennsylvania

THERE are three groups interested in the thermal exchanges of the human body, namely, the heating engineers, the physicians and the physiologists. In the English-speaking countries each of these groups by training uses a different set of physical units. The heating engineer uses B.T.U., square feet and  $^{\circ}\text{F}$ ., the physician calories, square meters and  $^{\circ}\text{F}$ ., and the physiologist calories, square meters and  $^{\circ}\text{C}$ . Consequently they find it difficult to make themselves

mutually understandable when discussing their common interest of heat exchange. It is our proposal to present a system of units such that all three groups may think in terms of a common and at the same time a practical system.

Thermal comfort in any environment is dependent on many variables. There is evidence that in the final analysis comfort is dependent largely upon skin temperature. The optimal average skin temperature for

comfort appears to be 92° F (33° C). Such an average skin temperature may be maintained in spite of exposure to cold if the clothing is properly chosen in relation to activity. Temperature regulation can be attained under less favorable conditions by adjustments of the skin circulation and evaporation of water when skin temperature may have higher or lower levels. Optimal comfort, however, is not achieved in the presence of such adjustments.

If thermal equilibrium is to be attained without the necessity of these physiological adjustments, it is obvious that the three factors concerned for a balance at an assumed optimal skin temperature are the rate of heat production of the body (dependent on the degree of muscular activity), the insulating value of the clothing and the environmental temperature. Consequently, the use of practical units for thermal activity and for insulation would provide a uniform system to describe comfortable conditions in relation to the heat exchange of man with his environment.

The proposed thermal activity unit may be defined as 50 calories per hour per square meter of the surface area of the individual (or 18.5 B.T.U./Hr./Sq.Ft.). This is approximately the metabolism of a subject resting in a sitting position under conditions of thermal comfort. This unit may be called 1 *met*, and may be utilized by any of the groups, regardless of the other system of units employed.

The unit for thermal insulation of clothing is logically the amount of insulation necessary to maintain in comfort such a sitting-resting subject in a normally ventilated room (air movement 20 ft/min or 10 cm/sec) at a temperature of 70° F (21° C) and a humidity of the air which is less than 50 per cent. This unit of insulation may be called 1 *clo*. Since, in the conditions outlined above, thermal equilibrium is maintained, the insulating value of 1 *clo* can be expressed and defined in terms of the common system of units.

Thermal insulation is the resistance offered to flow of heat, just as electrical insulation is related to flow of electricity. It is measured by the ratio of the difference in temperature between two surfaces, to the flow of heat per unit area that results. Thermal insulations thus estimated and expressed in *clo* units, may be treated mathematically just as are the comparable electrical resistances expressed in ohms. For men in the conditions already specified, it may be assumed that 24 per cent. of the resting metabolic heat is dissipated by evaporation of insensible perspiration. The remaining heat transmitted through the clothing is, therefore, 38 (76 per cent. of 50) Cals./Hr./Sq.M. The difference in temperature concerned is 33°-21° C. Then the total insulation, which is the sum of the insulation of the clothing,  $I_{Cl}$ , and that of the ambient air,  $I_A$ , is given in metric units by the equation

$$I_{Cl} + I_A = \frac{33 - 21}{38} = 0.32 \frac{^{\circ}\text{C.}}{\text{Cals./Hr./Sq. M.}}$$

From previous work<sup>1</sup> at the John B. Pierce Laboratory, the insulation of the air in metric units at the air movement cited is

$$0.14 \frac{^{\circ}\text{C.}}{\text{Cals./Hr./Sq. M.}}$$

Consequently, the insulation of the clothing, which is equal by definition to 1 *clo*, is

$$0.32 - 0.14 = 0.18 \frac{^{\circ}\text{C.}}{\text{Cals./Hr./Sq. M.}}$$

The *clo* unit is therefore defined as

$$0.18 \frac{^{\circ}\text{C.}}{\text{Cals./Hr./Sq. M.}} \text{ or } 0.88 \frac{^{\circ}\text{F.}}{\text{B.T.U./Hr./Sq. Ft.}}$$

In general, the relation between the insulation of the clothing,  $I_{Cl}$ , that of the ambient air,  $I_A$ , the heat production,  $M$ , the evaporated loss,  $E$ , and the temperature of the air,  $T_A$ , for optimal comfort expressed in *Met* and *Clo* units is

$$I_{Cl} + I_A = \frac{33^{\circ} - T_A}{9.0 (M - E)}, \text{ for } ^{\circ}\text{C.},$$

or

$$= \frac{92^{\circ} - T_A}{16.2 (M - E)}, \text{ for } ^{\circ}\text{F.}$$

These equations hold only for muscular activity when no external work is accomplished. When the latter is the case the work performed,  $W$ , must also be subtracted in the denominator from the total heat production,  $M$ .

The value of  $I_A$  varies with the surrounding air movement, whether this be produced by wind or the activity of the subject. The variations in  $I_A$  so produced are indicated in Table 1. Since the heat loss

TABLE I  
VARIATIONS IN INSULATION OF AMBIENT AIR IN CLO UNITS

Air movement		Resting sitting	Level walking		
			Slow	Normal	Fast
Normal indoors	( 20 F.P.M.)	.78	.37	.33	.29
Drafty indoors	(100 F.P.M.)	.40	.32	.29	.26
Normal outdoors	( 5 M.P.H.)	.30	.24	.22	.20
Windy outdoors	( 20 M.P.H.)	.19	.18	.17	.16

is determined by the total insulation, it is obvious that the effect of variations in  $I_A$  produced by air movement is less important, the heavier the clothing. It may also be seen that the total insulation of the air plus normal clothing is reduced 33 per cent. if the subject changes from sitting indoors to sitting outdoors on a windy day. On the other hand, if the subject is doing level walking the reduction is only 12 per cent.

It is now possible to predict what are the optimal temperatures for persons wearing normal clothing (1

<sup>1</sup> Winslow, Gagge and Herrington, *Am. Jour. Physiol.*, 131: 79, 1940.

clo) engaged in the following degrees of exercise. It is assumed, for purposes of analysis, that 24 per cent. of the total energy production is lost by evaporation, and that, as before, the optimal skin temperature for comfort in exercise is  $92^{\circ}$  ( $33^{\circ}$  C). Neither of these assumptions are likely to be precisely true. The optimal temperatures are given in Table II.

TABLE II  
OPTIMAL TEMPERATURES FOR COMFORT WITH EXERCISE IN  
NORMAL CLOTHING

Place	Resting sitting M = 1	Slow level walking M = 2	Normal level walking M = 3	Fast level walking M = 4
Normal indoors.	70.0° F	58.4° F	43.0° F	28.5° F
Drafty indoors..	74.8°	59.6°	45.6°	30.0°
Normal outdoors	76.0°	61.5°	47.0°	33.0°
Windy outdoors	77.6°	63.2°	48.8°	35.0°

It may be deduced from Table II that if the external temperature is much above that indicated, normal equilibrium can only be attained by increasing the evaporative heat loss through sweating. The amount of such increase can be approximately estimated. For instance, if an individual is walking fast indoors (producing 4 mets) at a temperature of  $58.4^{\circ}$  F, at which only 2 mets can be dissipated with comfort, the additional 2 mets must be lost by evaporation. (For more precise predictions, the changes in insulation of the ambient air with activity would have to be considered.)

Also the ideal amount of clothing, in clos, necessary for comfort for various degrees of rest and exercise in different outdoor environmental temperatures may be predicted as shown in Table III.

The net efficiency of the human body in performing external work does not exceed 20 per cent., i.e., in doing  $\frac{1}{2}$  met of external work the extra heat production will be at least  $2\frac{1}{2}$  mets, and the total will rise to at least  $3\frac{1}{2}$  mets. In many cases the efficiency is far less, as in level walking where the heat production rises to

TABLE III  
IDEAL CLOTHING FOR COMFORT

Environmental temperature	Resting sitting	Slow level walking	Normal level walking	Fast level walking
70° F—Normal outdoors	1.5	.7	.4	.3
50° F— " " "	3.1	1.5	.9	.7
30° F— " " "	4.7	2.3	1.5	1.1
0° F— " " "	7.2	3.5	2.3	1.7

several mets without the accomplishment of any external work. Using the figure of 20 per cent., the maximum clothing that could be worn in comfort in a given task may be calculated. For example, a mountaineer weighing 160 pounds, surface area 1.9 square meters, climbing at the rate of 1,250 feet per hour, would accomplish a mean rate of work of 0.75 mets. The minimal total metabolism would be 4.75 mets, and the heat to be lost 4.0 mets. Since fast level walking has been assumed as equivalent to 4 mets, it may be seen from Table III that at an external temperature of  $30^{\circ}$  F without wind, the maximal clothing he could wear for comfort would be about 1 clo.

The advantage of using the practical units, *met* and *clo*, instead of the classical metric and British units is that they describe energy and insulation values in terms of familiar concepts. One *clo* approximately is the value of the insulation of one's everyday clothing (and incidentally of a heavy top coat alone). The additional insulation conferred by top coats, etc., may be expressed in these units. One *met* unit varies in absolute amount with the size of the individual. For a man of average size it is approximately equivalent to the heat generated by a 100-watt lamp. Thus, speaking in units associated with one's normal experience, the engineers, the physicians and the physiologists should be able to use their individual training more effectively in a common effort to solve current problems of heating and ventilation, as well as those of the physiological adjustments associated with the maintenance of heat balance.

## OBITUARY

### FRANK BURR MALLORY

DR. FRANK BURR MALLORY died at his home in Brookline, Mass., on September 27, at the age of 78. Dr. Mallory was born in Cleveland, Ohio, on November 12, 1862. He graduated from Harvard College in 1886 with the degree of A.B. He received his A.M. and M.D. from Harvard Medical School in 1890. He became associated with Harvard Medical School in 1890, first as assistant in histology, later as assistant in pathology. He was appointed assistant professor of pathology in 1896, associate professor in 1901 and professor in 1928. He retired with the title of

emeritus professor in 1932. He joined the pathological staff of the Boston City Hospital in 1891 and was made pathologist in 1908. In 1932, at the age of 70, he retired, becoming consulting pathologist.

Dr. Mallory received the honorary degree of Sc.D. from Tufts College in 1928 and from Boston University in 1932. He was awarded the Kober medal in 1935 by the Association of American Physicians for outstanding service in pathology. In the same year he received the gold-headed cane from the American Association of Pathologists and Bacteriologists. This cane was presented to the association by Dr. Harold

C. Ernst to be awarded for special merit. The previous recipients of this honor were Dr. William H. Welch and Dr. Theobald Smith.

Dr. Mallory served as treasurer of the American Association of Pathologists and Bacteriologists from 1911 to 1940. He also was a past president of this organization. In 1923 he became editor-in-chief of the *Journal of Medical Research* and in 1925, when that journal became the *American Journal of Pathology*, he continued to serve in the same capacity until 1940. Dr. Mallory was a member of numerous American scientific societies. He was also a corresponding member of the Royal Medical Society of Budapest, a member of the Deutsche Pathologische Gesellschaft and an honorary member of the Pathological Society of Great Britain and Ireland.

In 1897, he published, with Dr. J. Homer Wright, "Pathological Technique." This went through eight editions, a final revision appearing in 1938. Dr. Mallory's "Principles of Pathologic Histology" was published in 1914.

Among Dr. Mallory's numerous contributions to the literature may be mentioned his studies on the classifications of tumors, technical methods, cirrhosis of the liver and infectious diseases. He early evinced a keen interest in staining methods and his third paper, published in 1895, while working with Ziegler in Freiburg, was the first of a long series of papers dealing with technical methods. In addition to developing new stains, he always stressed the importance of precision in histopathological procedures and insisted on the maintenance of high standards in his laboratory. Through the use of his methods, he contributed much of prime importance to the classification of tumors based on morphological characteristics. He was an exceedingly keen observer and his diagnostic ability was such that he was regarded by many as the court of last appeal in difficult or unusual cases.

Dr. Mallory's earlier papers were illustrated by drawings, but in 1901 he began using microphotographs. He was greatly interested in this branch of photography and developed it to a high degree of perfection. He was extremely critical of his own work and would discard everything that did not satisfy his ideals. As an editor he also demanded from contributors that their illustrations be of high quality. As a result the journals he edited were noted for the excellence of their illustrations.

In the fiftieth anniversary year book of his college class, he wrote, "I can say that I have been able to work all my life at just what I wanted to, to make a modest but sufficient income for a comfortable living and to take a lot of pleasure out of my existence." That statement well expressed his attitude towards his work. He was devoted to his laboratory and every-

thing connected with it. He was endowed with a divine enthusiasm which was unaffected by age or infirmity. After his retirement as pathologist in 1932, he continued to come to the laboratory just as regularly as before. He was one of the first to arrive in the morning and always came in on Sunday mornings. He was actively engaged in experimental work up to the time last February when he was compelled by his physical condition to leave the laboratory.

One of his great services to medicine was the training of young men in pathology. The number of graduates who were trained under him was approximately 125. Many of them are preeminent not only in pathology but also in clinical medicine as well. He took a great interest in the members of his staff, and their contact with him was close. He strove ceaselessly to instill in them his high ideals and to imbue them with his intense interest in pathology in all its various aspects. As a result of their service under him, his graduates received a thorough grounding both in morphology and in the application of technical procedures. There was always a demand for Mallory-trained men throughout the country both by medical schools and by hospitals.

Dr. Mallory was very fond of the outdoors. He early developed an interest in botany which he maintained throughout his life. He was a tennis enthusiast and played up until a few years ago. In this game, as in his laboratory life, he insisted upon the importance of proper technic. When he witnessed a match between experts, he was as much, if not more, interested in the form of the contestants as in the match itself. Canoeing also was a favorite pastime with him, and for many years he spent Saturday afternoons on the Charles River. Throughout his life, he was a great walker and when increasing age interfered with his other activities, he continued this form of exercise up until a few months of his death.

The death of Dr. Mallory has meant not only a great loss to scientific medicine but an equally great loss to all those who were fortunate enough to know him as a man.

F. PARKER, JR.

BOSTON CITY HOSPITAL

## RECENT DEATHS

DR. ERNEST EVERETT JUST, for twenty-six years head of the department of zoology at Howard University, a member of the faculty for thirty-four years, died on October 27 at the age of fifty-eight years.

JOSEPH S. STANLEY-BROWN, from 1892 to 1932 editor of the *Proceedings* of the American Geological Society, died on November 2 at the age of eighty-three years.

## SCIENTIFIC EVENTS

### THE PERMANENT SCIENCE FUND OF THE AMERICAN ACADEMY OF ARTS AND SCIENCES

INCOME from the Permanent Science Fund, according to agreement and declaration of trust, shall be applied by the American Academy of Arts and Sciences to such scientific research as shall be selected "... in such sciences as mathematics, physics, chemistry, astronomy, geology and geography, zoology, botany, anthropology, psychology, sociology and economics, history and philology, engineering, medicine and surgery, agriculture, manufacturing and commerce, education and any other science of any nature or description, whether or not now known or now recognized as scientific, and may be applied to or through public or private associations, societies, or institutions, whether incorporated or not, or through one or more individuals."

Applications for grants under this indenture are considered by a committee of this academy on stated dates only. The next meeting to consider applications will be held on February 15, 1942. Applications should be made on special forms furnished by the committee. Correspondence, including requests for application blanks, should be addressed to the chairman of the Committee on the Permanent Science Fund, Professor John W. M. Bunker, Massachusetts Institute of Technology, Cambridge, Massachusetts.

Grants-in-aid, varying from \$150 to \$600, from this fund have been made to Warren Andrew, assistant professor of histology and embryology, Baylor University; to Forrest F. Cleveland, associate professor of physics, Illinois Institute of Technology; to Rita Guttman, instructor, Brooklyn College; to Rudolf Höber, visiting professor of physiology, University of Pennsylvania; to Lewis H. Kleinholz, instructor, Cambridge Junior College; to Irvin M. Korr, instructor, New York University; to Valy Menkin, assistant professor of pathology, Harvard Medical School; to George H. Parker, professor of zoology, emeritus, Harvard University; to Edward J. Schremp, assistant professor, University of Cincinnati; to Charles W. Turner, professor of dairy husbandry, University of Missouri; to Clarence Zener and Kenneth Fitzsimmons, associate professor and instructor, respectively, State College of Washington.

### NEW YORK INSTITUTE FOR HOSPITAL ADMINISTRATORS

A NEW YORK Institute for Hospital Administrators was conducted by the American College of Hospital Administrators at the Cornell University Medical College from October 20 to October 31, inclusive. The institute, the second of its kind, the first having been

held in New York in 1939, dealt particularly with the critical problems now confronting hospitals and included conferences on every phase of hospital management. A discussion of the aims of hospital administration was presented by Dr. S. S. Goldwater, president of the Associated Hospital Service of New York, and the problems of hospitals and the government were discussed by Dr. C. W. Munger, director of St. Luke's Hospital. The director of the institute, Dr. Munger, and the secretary, Dr. Jack Masur, executive director of Lebanon Hospital, were in charge of the program.

Hospital administration under wartime conditions was described by Dr. Gerald F. Houser, who has recently returned from the Red Cross-Harvard Hospital, London, and an address on preparing hospitals for war conditions was given by Dr. Albert G. Engelbach, director of the Cambridge Hospital. Other problems relating to hospitals and national defense were covered in a round-table discussion. Field trips were conducted through the New York Hospital-Cornell University Medical College, the offices of the Associated Hospital Service and the department of nutrition of the New York, Presbyterian and St. Luke's Hospitals. Dr. Willard C. Rappleye, commissioner of hospitals of the City of New York, is a member of the executive committee.

Cooperating with the American College of Hospital Administrators in conducting the institute were the faculty of the Cornell University Medical College, the Greater New York Hospital Association, the Hospital Council of Greater New York and hospital associations of the states of New York, Connecticut, Maine, Massachusetts, New Jersey, Pennsylvania and Rhode Island.

The institute was closed with a dinner on October 31, when certificates were presented to those who had participated.

### PROCEEDINGS OF THE FEDERATION OF AMERICAN SOCIETIES FOR EXPERIMENTAL BIOLOGY

THE Federation of American Societies for Experimental Biology will issue in March, 1942, the first number of a quarterly publication to be named the *Federation Proceedings*. This will be published by an editorial board representing the five constituent societies of the federation: The American Physiological Society, The American Society of Biological Chemists, The American Society for Pharmacology and Experimental Therapeutics, The American Society for Experimental Pathology and The American Institute of Nutrition.

Four numbers will be published each year. The

March issue will appear just previous to the annual meeting of the federation, and will be composed of two parts. Part I will include the abstracts of all the papers to be presented at the annual meeting, about a thousand in all. These abstracts will be segregated as to society origin and will be indexed according to subjects and authors. Part II will comprise the program of the scientific sessions of all the constituent societies of the federation. The June and September issues will include the full text of perhaps twenty of the papers presented at the annual meeting as selected by the editorial board, including probably the papers on the joint program of the federation as a whole as well as the papers of one symposium of each of the five societies. The December issue will include material pertinent to the federation membership, which was formerly published in the *Federation Yearbook*, which will hereafter be discontinued.

In the past each society has printed its own abstracts in advance of the meeting in a separate pamphlet. After the meeting the abstracts were republished in permanent form in the journals of the various societies. In the future a single publication will suffice and abstracts of all the societies will be available in a single volume. Moreover, journal space formerly devoted to abstracts will now be available for the usual scientific papers. The new procedure will be more convenient for reference and will be on the whole more economical. This new publication is certain to be in great demand in libraries because of the large number of short papers which it will contain and to which frequent reference will be made in the literature. In addition, it will make universally available a certain number of the more valuable papers read at the annual meeting which only relatively few persons can hear at the time of actual delivery.

The *Federation Proceedings* will be distributed on payment of dues without further charge to the seventeen hundred members of the federation. The subscription price to non-members will be \$4.00 (\$4.50 foreign), payable in advance. Single issues may be purchased, if ordered in advance of publication, at prices to be determined at the time of issue. Subscriptions and other communications concerning advertising space, etc., should be addressed to: Dr. D. R. Hooker, Managing Editor, 19 West Chase Street, Baltimore, Maryland.

### BOSTON MEETING OF THE GEOLOGICAL SOCIETY OF AMERICA

The fifty-fourth annual meeting of the Geological Society of America will be held from December 29 to 31 at the Hotel Statler, Boston, under the auspices of the Geological Society of Boston, the Massachusetts Institute of Technology and Harvard University.

The address of the retiring president, Dr. Charles P. Berkey, professor emeritus of geology of Columbia University, will be delivered in the Ball Room, on Monday evening, December 29, at 8 o'clock. It will be followed by a smoker.

Associated societies that will hold meetings in conjunction with the Geological Society are:

The Paleontological Society, thirty-third annual meeting, secretary, H. E. Vokes, American Museum of Natural History, New York.

The Mineralogical Society of America, twenty-second annual meeting, secretary, Paul F. Kerr, Columbia University.

The Society of Economic Geologists, twenty-second annual meeting, secretary, W. D. Johnston, Jr., U. S. Geological Survey.

The Society of Vertebrate Paleontology, first annual meeting, secretary, George G. Simpson, American Museum of Natural History, New York.

There will be an all-day tour of Boston Harbor and historic Boston on Tuesday, December 30, and the annual dinner will be held in the ball room of the Hotel Statler at 7 o'clock in the evening. Trips for small groups will be arranged on request. Because of the uncertainty of weather conditions and probable gasoline rationing, no geological trips have been planned. The local geologists, however, will be glad to make tentative plans for informal trips. Any one interested should communicate with Dr. Cornelius S. Hurlbut, Jr., department of mineralogy and petrography, Harvard University, Cambridge, Mass., giving that phase of the local geology in which he is interested. During the meeting fellows of the society are invited to visit the departments of geology at Harvard University and the Massachusetts Institute of Technology.

The Geological Society will join with Section E of the American Association for the Advancement of Science, the Texas Academy of Science and the Association of American Geographers in sponsoring the meetings to be held in Dallas on December 29, 30 and 31. Hugh D. Miser as retiring vice-president will deliver the principal address: "Quartz Veins in the Ouachita Mountains of Arkansas and Oklahoma." The subjects of the three days of meetings are scheduled as follows:

December 29: "Structure and Stratigraphy of the Southwest."

December 30, morning session, jointly with the American Geophysical Union: "Relation of Geology to the Ground-Water Problems of the Southwest."

December 30, afternoon session, jointly with the Section on Anthropology: "Early Man in North America."

December 31: "Regional Geography of the Southwest."

Members of the associated societies are urged to submit their titles and abstracts to their secretary at once to meet the requirements of the Joint Program Committee.

#### AWARD OF THE WILLIAM H. NICHOLS MEDAL

DR. DUNCAN A. MACINNES, of the Rockefeller Institute for Medical Research, has been awarded the 1942 William H. Nichols Medal of the New York Section of the American Chemical Society in recognition of his "outstanding investigations on electrolytes and the development of techniques which have immeasurably enriched both the theory and practice of modern electrochemistry." His researches have contributed to the development of the glass electrode, widely used in industry. He has also made important investigations in the field of biological chemistry.

According to the statement given out by the jury of award

For many years Dr. MacInnes has been engaged in fundamental researches on the theory of solutions, and his precise studies have furnished much of the information which we now possess on the behavior of electrolytic solutions. He was one of the pioneers in studying the properties of the glass electrode and in establishing the conditions under which this very useful device may be used for the precise measurement of hydrogen ion concentration.

On the basis of these studies the electrode is now a recognized and dependable device which finds wide industrial use. More recently, Dr. MacInnes and his associates at the institute have turned their interest to the motion of biologically important solutions in an electric field and their experimental investigations in electro-

phoretic phenomena have greatly increased our knowledge of the protein content of the blood serum. These more recent investigations and the successful results are largely based on Dr. MacInnes's earlier studies on simpler inorganic systems.

The presentation will be made at a meeting of the New York Section on March 6. Founded in 1902 by the late Dr. William H. Nichols, a charter member of the American Chemical Society and chairman of the board of the Allied Chemical and Dye Corporation, the medal is awarded annually to "stimulate original research in chemistry."

Previous recipients of the award were: John M. Nelson, Phoebus A. Levene, Joel H. Hildebrand, Irving Langmuir, James Bryant Conant, Frank C. Whitmore, William M. Clark, Charles A. Kraus, Hugh S. Taylor, Julius A. Nieuwland, Gilbert N. Lewis, Charles L. Parsons, Claude S. Hudson, Marston T. Bogert, Henry C. Sherman, Roger Adams, William A. Noyes, Thomas Midgley, Samuel C. Lind, Leo H. Baekeland, H. C. P. Weber, Edward C. Franklin, M. A. Rosanoff, C. W. Easley, T. B. Johnson, Charles James, M. H. Walker, M. B. Bishop, E. B. Voorhees, William L. Evans, Moses Gomberg, Samuel E. Sheppard, John A. Wilson and Dr. Linus Pauling, head of the division of chemistry and chemical engineering at California Institute of Technology.

Members of the 1942 medal jury in addition to Professor MacTavish were Professor Louis P. Hammett, of Columbia University; Dr. Robert Calvert, consulting chemist and chemical patent attorney; Professor Ralph H. Muller, of New York University, chairman of the section, and Dr. Cornelia T. Snell, secretary.

## SCIENTIFIC NOTES AND NEWS

At the thirty-second annual dinner of the Radio Club of America on November 1, the fourth award of the Armstrong Medal for "outstanding contributions to the radio art" was made to Harry William Houck. The citation reads: "After assisting at the birth of the superheterodyne in Armstrong's (Major Edwin H. Armstrong, of Columbia University, inventor of the superheterodyne receiver and father of the current FM system) wartime laboratory in Paris he designed the second-harmonic superheterodyne, first type to be placed in large commercial production. Radio receivers operating from alternating current power lines leaned heavily on the technique, designs and inventions of the medalist."

A TESTIMONIAL dinner in honor of Dr. George H. Meeker, dean emeritus of the Graduate School of Medicine of the University of Pennsylvania, was

given on September 29, marking his retirement as dean. Dr. George M. Coates was chairman, and Dr. George Morris Piersol, toastmaster. Dr. Thomas S. Gates, president, and Dr. Alfred N. Richards, vice-president for medical affairs, spoke for the university; Dr. William R. Nicholson for the Graduate School, and Dr. George E. Pfahler for the Medico-Chirurgical College of Philadelphia, where Dr. Meeker taught before the school was taken over by the university.

DR. GILBERT H. CADY, senior geologist and head of the Coal Division of the Illinois State Geological Survey, was honored at a testimonial dinner in Urbana on the evening of September 27, immediately following the close of the fiftieth anniversary celebration of the University of Chicago, in which Dr. Cady had led the symposium on coal geology. The occasion was in recognition of his thirty-five years of service

in geology, during which he has contributed in a major degree to the training of his students, assistants and associates, many of whom were present at the dinner to do him honor. A portrait of Dr. Cady was presented.

THE honorary degree of doctor of science was conferred on October 6 by Northwestern University on Dr. Irving S. Cutter, since 1925 until his retirement this year as dean emeritus, dean of the Medical School. Dr. Leslie B. Arey, Robert Laughlin Rea professor of anatomy, presided, and Dr. James Roscoe Miller, the new dean of the Medical School, reviewed his service to the school. A portrait of Dr. Cutter was unveiled.

THE Clement Cleveland Medal, awarded annually for conspicuous service to cancer education, was presented on October 22 at a meeting held at the Advertising Club of New York to Abbott Kimball, president of the Kimball Advertising Agency, at the opening of the campaign to raise funds for the New York City Cancer Committee.

THE James H. McGraw Medal and purse of the National Electrical Manufacturers was presented at a luncheon held at the recent New York meeting to Dwight G. Phelps, vice-president of Colt's Patent Fire Arms Manufacturing Company. The award was made in recognition of his "distinguished contribution to the manufacturing branch of the electrical industry in the surveying of wage experience within the industry to establish a sound basis for company policy and for minimum wage control under the Walsh-Healy law."

SIDNEY DALE KIRKPATRICK, editor of *Chemical and Metallurgical Engineering*, has been elected president of the American Institute of Chemical Engineers for the year 1942. James LeRoy Bennett, manager of chemical operations for the Hercules Powder Company of Wilmington, Del., has been elected vice-president.

THE National Institute of Psychology, at a meeting at Northwestern University, Evanston, Ill., on September 4, elected officers as follows: *President*, Dr. John A. McGeech, the State University of Iowa; *Vice-president*, Dr. Ernest R. Hilgard, Stanford University; *Secretary-treasurer*, Dr. G. R. Wendt, Wesleyan University; *Directors*, Dr. Walter R. Miles, Yale University, and Dr. L. L. Thurstone, University of Chicago.

THE Society for the Study of Growth and Development at its annual meeting and symposium at Dartmouth College, which was held from July 7 to 11, elected the following officers: *Chairman*, Dr. Paul Weiss, Chicago; *Treasurer*, Dr. J. Walter Wilson,

Brown; *Secretary*, Dr. Kenneth V. Thimann, Harvard; *Members of the Executive Committee*, Dr. B. H. Willier, the Johns Hopkins; Dr. E. W. Sinnott, Yale, and Dr. O. L. Sponsler, California. The executive committee is developing plans for a closer relation with the journal *Growth*, and the adoption of *Growth* as the official organ of the society.

THE Virginia Chapter of Sigma Xi on October 22 elected the following officers: *President*, Dr. A. N. Vyssotsky, astronomy; *Vice-president*, Dr. L. B. Snoddy, physics; *Secretary*, Dr. Joseph K. Roberts, geology; *Treasurer*, Dr. Lawrence R. Quarles, engineering.

New national officers for the Wasmann Biological Society, to serve for the year 1941-1942, are: *President*, Dr. Harold A. Harper, University of San Francisco; *Vice-president*, the Rev. Charles J. Wideman, S.J., Loyola University, Chicago, and *Secretary-Treasurer*, the Rev. Dominic LaPorte, S.J., Gonzaga University. Other new members of the General Council are: Dr. Carl G. Kadner, Loyola University, Los Angeles, and the Rev. Frank Gubbins, S.J., Gonzaga University. Dr. Edward L. Kessel will continue as managing editor of *The Wasmann Collector*.

JOSEPH W. BARKER, dean of the School of Engineering of Columbia University and chief of the Division of Training Liaison and Coordination of the United States Navy, has been appointed professor of electrical engineering and acting executive officer of the department of electrical engineering. He succeeds Professor Frederick W. Hehre, who died on July 27.

JAMES L. GABBARD, instructor in chemistry at the University of Kentucky, has become professor of chemistry at the Michigan State Normal College, Ypsilanti.

DR. L. D. WOOSTER, for thirty years head of the department of zoology of the Fort Hays Kansas State College at Hays and during the past two years dean of the undergraduate division of the college, has been made president. In a recent note in *SCIENCE* it was stated incorrectly that Dr. Wooster had become president of "the State Teachers College."

AFTER serving fifteen years at Field Museum of Natural History as assistant curator and curator of physical anthropology, Dr. Henry Field has submitted his resignation. Dr. Field began his services at the museum on October 1, 1926. Since February 16, 1941, he has been associated with the Library of Congress in Washington, D. C., being on leave of absence from the museum.

DR. MARTIN D. YOUNG has been appointed director of the Malaria Research Laboratory, U. S. Public

Health Service, at the South Carolina State Hospital, Columbia, S. C. He succeeds the late Dr. Bruce Bayne.

F. S. BLANCHARD, of Scarsdale, N. Y., president of the United States Institute for Textile Research, has been appointed textile consultant in the Bureau of Industrial Conservation of the Office of Production Management.

FRANK E. MOORE, chairman of the department of poultry husbandry and extension poultryman of the North Dakota Agricultural College, has been appointed poultry coordinator to assist in the administration of the National Poultry Improvement Plan. Mr. Moore, whose appointment was effective on October 24, succeeds J. D. Sykes, who resigned several months ago.

JAMES D. BUMP, instructor in geology and museum curator and technician at the South Dakota School of Mines, Rapid City, has been made director of the museum.

C. N. BALDWIN, director of the Washington Zoological Park at Portland, Ore., formerly in charge of the collection of animals on San Simeon Ranch, owned by William Randolph Hearst, has been appointed director of the San Francisco Zoological Garden.

CHARLES G. BRANNAN has been appointed regional director of the Forest Service Administration, Region Ten, with headquarters at Denver, Colo., to have charge of activities in Montana, Wyoming and Colorado except in the fourteen southeastern counties.

It is reported in *Industrial Standardization* that E. W. Ely, chief of the Division of Simplified Practice of the National Bureau of Standards, and Robert A. Martino, of the Codes and Specifications, have been released by the Department of Commerce to work with the new Conservation Bureau of the Office of Production Management. The National Bureau of Standards announces that in connection with the new set-up it has changed its procedure to make it possible for the government to initiate simplification projects, either through the Office of Production Management or the Department of Commerce. Hitherto, only non-governmental organizations have had the authority to initiate these projects.

DR. W. R. COE, professor emeritus of zoology at Yale University, has returned to the Scripps Institution of Oceanography, La Jolla, of the University of California, to resume studies of the California mussel made in collaboration with Dr. Denis L. Fox, assistant professor of marine biochemistry.

PHYSICIANS from various parts of the world who have recently visited the Medical School of the Uni-

versity of California include, from Argentina, Dr. Juan Allende, clinical professor of surgery at the Cordoba University; Dr. Felipe Carranza, specialist in malignant disease at the University of Buenos Aires, and Dr. Jose A. Saralegui, of the University of Buenos Aires and director of the Municipal Institute of Radiology and Physiotherapy, and from China, Dr. Chien-liang Hsu, instructor in radiology, and Dr. W. A. Ma, of the department of anatomy of the Peiping Union Medical College.

DR. KARL F. MEYER, professor of bacteriology and director of the Hooper Foundation of the Medical School of the University of California, will give the Craig Lecture at the annual meeting of the American Society of Tropical Medicine in St. Louis on November 10, and on November 14 and 15 he will speak before the Southern California Medical Association.

THE first Edwin R. Kretschmer Memorial Lecture of the Institute of Medicine of Chicago, under a foundation established by Dr. and Mrs. Herman L. Kretschmer in memory of their son, will be delivered on November 11 by Dr. John H. Lawrence, assistant professor of medicine in the University of California Medical School. The title of the lecture is "Studies on Leukemia and Allied Diseases with Artificial Radioactivity."

THE final dates for the Salmon Memorial Lectures which Dr. Robert D. Gillespie, psychiatric specialist of the British Royal Air Force, will deliver in key cities of this country and Canada, have been announced as follows: Toronto, November 19; Chicago, November 21; New Orleans, November 22; Washington, November 24 and 25; San Francisco, November 27; Philadelphia, November 30.

THE thirty-fourth annual meeting of the American Society of Animal Production will be held at the Hotel Sherman, Chicago, on November 28, 29 and 30.

PRESENTATION has been made to the New York Botanical Garden of the herbarium of the late Howard J. Banker, as announced in a biography of Dr. Banker in the July-August issue of *Mycologia*. The gift was made by Mrs. Banker to carry out her husband's request. The herbarium consists of 4,477 specimens, and while the majority represent the lower plants, principally fungi, there are more than 2,000 examples of the higher plants, many of them carefully and artistically mounted.

THE Association of Medical Students is sponsoring a scholarship competition among medical students. The Schering Award of the association offers scholarships to medical students preparing the best dissertations on the history of endocrine research. The scholarships have been donated by the Schering Corporation in order to encourage the current interest

in endocrinological developments by offering talented medical students a chance to pursue an inquiry into the history of endocrine research. Further informa-

tion can be obtained by addressing the Committee on the Schering Award, Association of Medical Students, 25 Madison Square North, New York, N. Y.

## DISCUSSION

### THE TERMINOLOGY OF THE COMPONENTS OF COMPLEMENT<sup>1</sup>

It is well established that hemolytic complement is composed of four functionally distinct components which individually are inactive.<sup>2-5</sup> Treatment of serum with distilled water,<sup>2</sup> carbon dioxide,<sup>6</sup> or dilute hydrochloric acid<sup>10</sup> has been shown to separate complement into two thermolabile components. One globulin fraction has been designated the "mid-piece," and the so-called albumin fraction has been termed the "end-piece." In addition, it has been shown that yeast cells or an insoluble carbohydrate isolated from yeast inactivate a relatively heat-stable component of complement, the "third component."<sup>3,7</sup> It has also been shown that dilute ammonia and amino compounds capable of reacting with carbonyl groups destroy another thermostable fraction, the "fourth component."<sup>4,8</sup>

The two thermolabile components of complement owe their terminology to their action rather than to their nature. The two thermostable fractions were named "third" and "fourth" components after their order of discovery.

During studies on the separation and characterization of the components of complement,<sup>11</sup> electrophoretic diagrams were obtained of mid-piece and end-piece prepared by the carbon dioxide method, as well as of complement deprived of its third component (zymin-treated) and of its fourth component (ammonia-treated). The diagrams are presented in Fig. 1, and indicate that the so-called globulin fraction or mid-piece contains at least four distinct proteins, two of which have mobilities faster than any of those

Electrophoretic Schlieren Patterns of Normal Guinea Pig Serum and Guinea Pig Serum Treated With Various Reagents Which Separate or Destroy the Components of Complement

Descending Boundaries of the Proteins in Phosphate buffer of pH 7.7 of ionic strength 0.2. Scanning exposures made after electrolysis for 2½ hours.

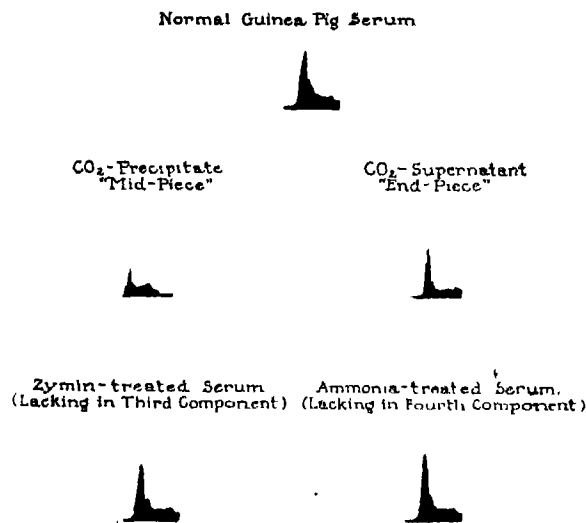


FIG. 1

originally present in whole serum; while the end-piece or so-called albumin fraction also contains at least four distinct proteins as judged electrophoretically, one of which appears to be  $\gamma$ -globulin. No significant difference is detected electrophoretically between normal serum and serum deprived of its fourth component. Serum lacking in third component shows a disturbance of the  $\alpha$ -globulins.

It is evident from these diagrams that the terms "mid-piece," "end-piece," "albumin fraction," "globulin fraction" are misleading and unsatisfactory. Therefore, it is suggested that the four components of complement be designated by the following symbols:

- C'1—mid-piece
- C'2—end-piece
- C'3—third component
- C'4—fourth component

The terminology proposed for the complement components was arrived at after discussion and agreement with Dr. Michael Heidelberger.

L. PILLEMER  
E. E. ECKER

INSTITUTE OF PATHOLOGY,  
WESTERN RESERVE UNIVERSITY AND THE  
UNIVERSITY HOSPITALS OF CLEVELAND

<sup>1</sup> Aided by a grant from the Commonwealth Fund.

<sup>2</sup> H. von Buchner, *Arch. f. Hyg., Berlin*, 17: 179, 1893.

<sup>3</sup> E. von Dungern, *München. med. Wochenschr.*, 47: 677, 1900.

<sup>4</sup> J. Gordon, H. B. Whitehead and A. Wormald, *Biochem. Jour.*, 20: 1028, 1036, 1044, 1926.

<sup>5</sup> H. B. Whitehead, J. Gordon and A. Wormald, *Biochem. Jour.*, 19: 618, 1925.

<sup>6</sup> L. Pillemer, J. Seifter and E. E. Ecker, *Jour. Immunol.*, 40: 89, 1941.

<sup>7</sup> L. Pillemer and E. E. Ecker, *Jour. Biol. Chem.*, 137: 189, 1941.

<sup>8</sup> L. Pillemer, J. Seifter and E. E. Ecker, *Jour. Immunol.*, 40: 101, 1941.

<sup>9</sup> H. Liefmann, *München. med. Wochenschr.*, 56: 2097, 1909.

<sup>10</sup> H. Sachs and K. Altmann, cited from *Handbuch der Technik und Methodik der Immunitätsforschung*, Bd. 2: 309, 1909.

<sup>11</sup> L. Pillemer, E. E. Ecker, J. L. Oneley and E. J. Osba, *J. Exp. Med.*, 74: 297, 1941.

## THE PURIFICATION OF SPECTROGRAPHIC CARBONS<sup>1</sup>

GRAPHITE electrodes purified especially for spectrographic analysis are available at a rather high price; those ordinarily used contain appreciable amounts of impurities in varying numbers and varying quantities. However, owing to the high porosity of these electrodes it is readily possible to remove from them by chemical means all significant amounts of impurities.

The electrodes are treated for four hours with a mixture of equal parts of concentrated hydrochloric and nitric acids which is kept at a temperature slightly below the boiling point during this period. The acid is then poured off and the carbons are treated with redistilled water, which is kept at the boiling point for an hour, and poured off. More water is added, and this process is repeated until the hot wash water has no acid odor. The carbons may then be dried in an oven and used.

Several hundred electrodes have been purified, with uniform success, by this method; the data which follow were taken on eight carbons from a typical batch. Spectrograms of these eight electrodes and of eight unpurified ones from the same lot were made with a concave grating spectrograph of moderate dispersion using the 220 volt DC arc, with a current of 20 amperes. The exposures were fifteen seconds. In the region from 2478Å to 3274Å, the unpurified carbons showed  $56 \pm 24$  lines, the greatest number being 110 and the least, 33. Calcium, magnesium, silicon, copper, iron, titanium and manganese were identified among the impurities.

The purified electrodes showed in the same region only  $2 \pm 1.7$  lines. Of the eight electrodes examined, five showed only the 2882Å silicon line, three showed very faint traces of copper, and one, a trace of magnesium. In the visible, the persistent calcium lines at 3934Å and 3968Å remained, but those from 4240Å to 4318Å were entirely absent.

RICHARD ZIETLOW  
PHILIP HAMM  
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MINNESOTA AGRICULTURAL  
EXPERIMENT STATION

## THE CORRECTION BY SCIENTISTS OF MANUSCRIPTS FOR THE PRESS

As a professional science reporter and interpreter of science for the layman I recently had the pleasurable experience of working with Dr. John A. Wilson, director of the Oriental Institute of the University of Chicago, in the preparation of an article relating to the new discoveries of the Mitannian civilization in

the Near East. Following the approved practice, employed by members of such organizations as the National Association of Science Writers, the manuscript was sent to Dr. Wilson for checking, prior to publication, to assure scientific accuracy.

Dr Wilson's prompt but careful treatment of this manuscript and the exceedingly clear manner in which his suggested changes were made—and why they were made—is a splendid example of how scientists can best cooperate in the dissemination of accurate, yet interesting, articles on science in the realm of modern journalism.

As an object lesson to other scientists who may, in the future, be asked by the various science reporters to edit manuscripts for accuracy, the following examples of Dr. Wilson's changes are cited:

*Original MS.:* "Science now knows that it was the almost mythical and mysterious race known as the Mitanni who introduced the horse and chariot to the Egyptians, the Hittites and other peoples and revolutionized. . . "

*Suggested change:* "Science now knows that mysterious people known as the Mitanni were important agents in introducing the horse and chariot to the ancient Near East and in revolutionizing. . . . "

*Reason:* Mitanni were not a biological "race"; term "people" less specific. The Mitanni were one segment of the great Indo-European migration, in which they brought the horse to upper-Mesopotamia, their cousins the Hittites brought it to Anatolia, their cousins the Kassites brought it to lower-Mesopotamia, and a more dilute mixture of Indo-Europeans, the Hyksos, brought it to Egypt.

Another example:

*Original MS.:* ". . . at a great mound near the headwaters of the Tigris and Euphrates Rivers. . . . "

*Suggested change:* ". . . at a great mound between the upper Tigris and Euphrates Rivers. . . . "

*Reason:* The mound of Tell Fakhariyeh is located somewhat like Des Moines in reference to the Mississippi and Missouri Rivers.

Other examples might be cited, but the important thing to note is the pattern which Dr. Wilson uses in his suggested changes. 1. The specific phrase in the original manuscript, which is erroneous or requires a different shade of meaning, is cited. 2. The suggested change is given, keeping as near to the wording of the original as is possible. 3. The reason for the change is given.

Most scientists, when asked to correct a rough manuscript, will obey point No. 1 listed above. Very few of them will follow point 2 in keeping as near to the original phraseology as possible. Still fewer will give the reason for the suggested change.

Point 2 is important because science reporters desire most the correction of errors of fact, or misinterpretation. If they write in the vernacular of the newspapers they do so because this simple language—

<sup>1</sup> Paper No. 1921 of the Scientific Journal Series, Minnesota Agricultural Experiment Station.

rather than technical phraseology—will be read by the newspaper public. Many scientists are unwilling to accept a simple way of saying something and adhere closely to strict scientific terminology.

Point 3 is important because the professional science writers, to-day, are intelligent, specialized and experienced journalists who do nothing except follow and report the latest developments in the world of science. They are willing and eager to correct errors or misinterpretations which may creep into their writings, but they appreciate the courtesy of explanations for the changes in their manuscript. Such explanations are the tribute of equality from the professional man in one field to the professional man in another field of related endeavor. It is only by such mutual respect and cooperation that the great work of ad-

vancing the dissemination of knowledge of science to the public can be raised to greater heights.

ROBERT D. POTTER,  
*Science Editor, The American Weekly*

## REPRINTS FOR EUROPEAN LABORATORIES

Most European laboratories are unable at present to obtain American (or British) scientific journals, but can receive reprints, especially if they are sent by first-class mail. In the past week I have received two letters from scientists in Denmark and Sweden complaining that their work was handicapped by unavailability of journals, and thanking me for reprints I had sent. This seems to indicate a very practical way for American scientists to aid their colleagues in Europe.

ROBERT B. DEAN

## QUOTATIONS

### SCIENCE SHOWS THE WAY

THE significance of the conference on Science and World Order has been two-fold. It has held aloft the torch of free scientific discussion between men of many nations on issues of vital importance to humanity—"the greatest torch," in the words of General Smuts's recorded message to the conference, "that the spirit of man has kindled in the modern world"; and it has emphasized the increasingly close relationship between science and government. The relationship has never been closer than in this war. Not only the fighting services but all other forms of governmental activity are increasingly dependent on science. This dependence has perhaps not yet been as fully realized everywhere as it should have been. There are still gaps due to obstructive traditionalism. Professor Haldane may be right in thinking that the potentially valuable services of men of science less persistent than himself are sometimes left unused; and, among lesser men, there are still too many stories of trained chemists working as orderlies or pay clerks. But in general the change in outlook has been undeniable and striking. It has not been confined to general staffs and civil servants. Men of science on their side have learned to regard themselves not as mere consultants sitting in remote laboratories but as active participants in front-line warfare and in the framing of military and administrative policy. The conference which ended last night has certainly not been "academic" in the invidious sense of the word.

More important in the long run even than relations between science and government are relations between science and the people. Much was said at the conference about planning for the future. But, as one speaker remarked, planning can never be more than an "administrative convenience" until it is brought

into direct contact with human needs. The American Ambassador, who presided at one session, spoke of the "wounded world of immediate needs and crowded wants" into which we shall move when hostilities end. In this world of the future it may sometimes be necessary to strike a nice balance between needs and wants. Clearly the needs of all have precedence over the wants of some. In such fields as health and nutrition much can be done by education to make people want most what they need most. But, save where military exigencies in time of war and restricted resources in time of peace are a limiting factor, intelligent planning must make allowance not only for human needs, but for human preferences and even for human caprice. There is nothing scientific about herding together in blocks of flats the people who want their own cottages and backyards.

In fact science, if it is to fulfil its human mission, will have to concern itself in future as much with the consumer as with the producer. This implies to some extent a reversal of past attitudes. But the whole conception of the needs and wants of the consumer as the starting-point of a program of reconstruction owes much to those who in recent years have worked out, especially in the field of nutrition, standards recognized as the necessary minimum for human well-being, and have shown how far existing standards, even in advanced countries, fall below them. The recognition of such standards was rightly described by Herbert Morrison as "a new social and political factor of the first importance." It has aroused the social consciences of all classes, and has established a principle accepted by all parties as an obligation overriding selfish or sectional interests. The war has forced on this country what Sir John Orr urged as a permanent and universal objective—"a food policy

based on nutritional needs." Nor are these considerations confined to problems of nutrition, though this may provide the simplest and most urgent field for their application. The almost equally elementary requirements of housing and clothing will also call after the war for comprehensive policies, the lines of which are already beginning to shape themselves. The same principles might easily be applied to some of the more sophisticated requirements of modern civilization. Mr. Morrison spoke of standards in education and in leisure; and Mrs. Hamilton invited science to bring into the kitchens of the workers those hitherto expensive "appliances and fittings" which would rationalize the burden of housekeeping for all classes and release a store of female capacity and energy at present absorbed by household duties.

Thus the conference did not disdain the domestic view. But its international composition was calculated to ensure that the problems under discussion would be placed in their world setting. Like all great modern problems, the contribution of science to the advancement of human welfare is a world-wide issue. It has been realized for many years that the substantial increase in standards of nutrition, which science has shown to be necessary on grounds of health and efficiency, provides the one prospect of overcoming the chronic crisis of so-called "over-production" which has overtaken every agricultural country in the world in the past twenty years. Sir John Orr quoted some striking figures to illustrate the expansion of agricultural production which would be needed in order to bring the nutrition of the whole population up to standard even in the United States, the richest country in the world; and he went on to argue that a policy of meeting nutritional needs everywhere would rule

out any danger of an agricultural slump for many years to come. What is true of the crisis of agriculture is true in a scarcely less marked degree of the crisis of industry. As Sir Harold Hartley suggested in his paper on world heat and power requirements, the economic vicissitudes of the present century may be largely due to the failure of the world to adjust itself to the "closing of the frontier"—the cessation of natural and automatic expansion into virgin territories—which approximately coincided with the end of the nineteenth century. Science continues to increase the world's productive capacity as rapidly under the new conditions as under the old. What it must now teach us to do, by releasing new sources of energy, is to substitute an organized and intensive expansion of consumption for the unorganized and extensive expansion of the previous period.

But, though science shows the way, it would be presumptuous to believe that science alone can lead us to the goal. The men of science themselves have moved far since the era of uncritical optimism, when progress was regarded as automatic and science as its predestined instrument. We need no evidence to-day that science can serve evil ends as well as good. It can be invoked to bolster up narrow sectional interests as easily as to promote the welfare of the community. This is no reproach to the instrument, but a reminder that the ultimate test of its value lies in the moral quality of the human purpose directing it. The most important service rendered by the conference of the past few days has been to bring to public knowledge the almost unlimited potentialities of human development and human well-being which science has to offer. Science provides the opportunity. There must also be the will to use it aright.—*The London Times*.

## SCIENTIFIC BOOKS

### CHEMISTRY

*Laboratory Manual for General College Chemistry.*

By JOSEPH A. BABOR and ALEXANDER LEHRMAN.  
289 pp. + appendices + 10 pp. graph paper. New York: Thomas Y. Crowell Company. 1940.

THIS laboratory manual is designed primarily for those students who have some background for chemistry. Accordingly, emphasis is placed on laboratory technique and on stressing the limitations of quantitative measurements. The numerous problems in the experiments elaborate upon principles and involve numerical calculations to illustrate quantitative relationships. It is interesting to note a detailed description of weighing has been omitted.

The material is presented in the "Work Book" or "Fill In" type of arrangement. An innovation in the

manner of printing is the use of two columns per page as employed by the scientific journals. Accordingly, it is not as difficult to read the printed matter as when the single column arrangement is used. It is unfortunate, however, that the amount of space provided for answers is too limited for the usual response that a teacher would expect.

Extensive appendices which include data frequently used in the solution of problems and in the performance of experiments are designed to place the responsibility upon the student for selecting pertinent information for use in a particular problem.

The exercises are especially well planned and given very explicit directions on laboratory technique. Each exercise begins with a discussion of principles and is followed by directions and problems.

An abridged Hubbard "Periodic Chart" is printed

on the back cover and will be very useful both to the teacher and the student. An ample supply of graph paper is furnished for use in the many experiments where data are plotted in order to illustrate the principles involved. The manual is on  $8\frac{1}{2} \times 11$  paper and bound with one of the newer type spiral binders.

The laboratory manual for "General College Chemistry" is very adaptable for use in the elementary chemistry laboratory.

L. L. QUILL

*Experimental General Chemistry.* By J. W. NECKERS, T. W. ABBOTT, K. A. VAN LENTE. 282 pp. New York: Thomas Y. Crowell Company. 1940. \$1.75.

SIXTY-ONE carefully selected experiments designed for a year's course in elementary general chemistry have been assembled in this laboratory manual. One distinctive feature of this book is the use of "Preliminary Exercises" which contain leading and pertinent questions about the purpose and the problems of each experiment. Each experiment is preceded by these preliminary exercises which are to be assigned in advance and handed in at the beginning of each laboratory period. These exercises are printed separately from the laboratory exercise with which they are associated. The fact that the student must do a certain amount of work previous to starting the actual laboratory study should facilitate the performance of the experiment as well as making the laboratory work more interesting.

The authors have utilized the term "spatula spoonful" whenever accurate quantities of solid reagents are unnecessary. This innovation is being used widely by teachers of chemistry at the present time. The scheme saves considerable time for experimental work and eliminates the necessity of waiting for a balance. Frequent references to industrial processes are included throughout the book.

The manual is a very practical, well-arranged and teachable book, on  $8\frac{1}{2} \times 11$  format. Adequate space in which the students may answer questions and do calculations is allowed. The custom of correlating the laboratory manual with several elementary text-books has been followed by these authors.

L. L. QUILL

*Physical Chemistry.* By A. E. MOELWYN-HUGHES. viii + 660 pp. Illustrated. New York: The Macmillan Company; London: Cambridge University Press. 1940. \$9.50.

THIS book is an ambitious attempt to present a complete development of modern theoretical chemistry in one volume. Actually it is a simplified version of Fowler and Guggenheim's "Statistical Thermodynamics," which any mathematically minded graduate stu-

dent might follow regardless of his preparation. The first 282 pages takes up the physical foundations—the fundamental constants, elementary quantum mechanics and statistical mechanics. The rest of the book applies these principles to thermodynamics, atomic and molecular spectra, dipole moments, chemical equilibria, kinetics of gas reactions and crystal structure. Every effort has been made to make the mathematics complete, often at the expense of brevity. "All theorems are derived; no proof is taken for granted." A large amount of carefully selected experimental data illustrates the physical principles. No problems to be worked out by the student are given.

The treatment of kinetic molecular theory is excellent, except for the use of the old values of the fundamental constants. The experimental basis of quantum mechanics is very complete. The mathematical derivation of quantum mechanics follows the historical approach and the reader is led through a maze of old Bohr theory which he must unlearn before starting the next chapter. Fifty pages are devoted to elementary wave mechanics, but the treatment does not get beyond the hydrogen atom. Perturbation methods and the nature of chemical bonds are not discussed. The chapter on thermodynamics is concise but not critical. For example, Trouton's rule is stressed but no mention is made of Hildebrand's modification. Intermolecular forces are discussed at some length. Diatomic spectra are stressed but predissociation is not mentioned.

The treatment of equilibria is the best feature of the book. Extensive tables of equilibrium constants, entropy and heat changes, etc., are given together with the original references. Some of the better known equilibria are studied in detail from both the experimental and theoretical angles.

The section on the theory of reaction rates is surprisingly weak. The contributions of Eyring are hardly mentioned. No calculation of an actual reaction rate is made. No mention is made of entropy of activation, and no attempt is made to interpret unusually fast or unusually slow reactions. Although Moelwyn-Hughes is a master of solution chemistry, no reactions in the liquid phase are considered.

A very useful summary of different types of rate equations and their integrated solutions is given in the appendix.

This book is far too advanced for an elementary course and too limited in scope for the usual course in advanced physical chemistry. Moelwyn-Hughes had an excellent goal in trying to systematize physical chemistry, but he placed so much emphasis on physical preliminaries that he did not have sufficient space to consider the chemical problems adequately.

JOSEPH O. HIRSCHFELDER

## SPECIAL ARTICLES

## PROGRESS REPORT ON POSSIBILITIES IN PROGENY-TEST BREEDING

THE extent to which plants and animals can be gradually modified by selective breeding over a series of generations in some predetermined direction, such as more rapid growth or increased yields—to mention only two examples from a very long list—as contrasted with the preservation of haphazard but inheritable modifications, known as “mutations,” is evidently of significance to the theory of evolution by means of natural selection, because if man can change the character of a population by suitable methods of selective breeding to a sufficient extent in some desired direction, it is not unlikely that the same amount of change can be made by natural selection, even if the rate of change is too small to be measured in a human lifetime. Men's views on the effectiveness of artificial selection have passed from belief in its power to produce very extensive, indeed almost unlimited, modification to skepticism so great that twenty years ago biologists practically abandoned active work in this field. This change of opinion arose from lack of success in continuing the modification beyond nearby limits, thus leading to the conclusion that the amount of modification is so restricted that further work along this line would be of little value.

However, new efforts lead to renewed hope that larger changes can be made in quantitative characters than was indicated by the earlier efforts. The renewed efforts are merely a beginning—a very small beginning, it is true. And though it would be very unwise to conclude from what has already been accomplished, that the present rate of progress will be maintained indefinitely, nevertheless, the change already made in velocity of growth processes indicates that we may perhaps accomplish with sufficient time these larger changes which the men who followed Darwin thought could be accomplished by purely phenotypic selection. At any rate, ambitious young men with great capacity for lifetime application to a single task have an opportunity to devote their energies to a field of work which promises abundant returns from their time and attention.

This report deals with an experiment in increasing the body weight of mice, first reported in the *Journal of Heredity* for February, 1938. Using the progeny-test methods there described, it has proceeded from the fourteen chronological groups<sup>1</sup> of that paper through twenty-eight, thus doubling the number of

groups during which the average weight of the mice has increased. The average weight of each of the fourteen new groups, added to the fourteen previously reported, is shown in Fig. 1.

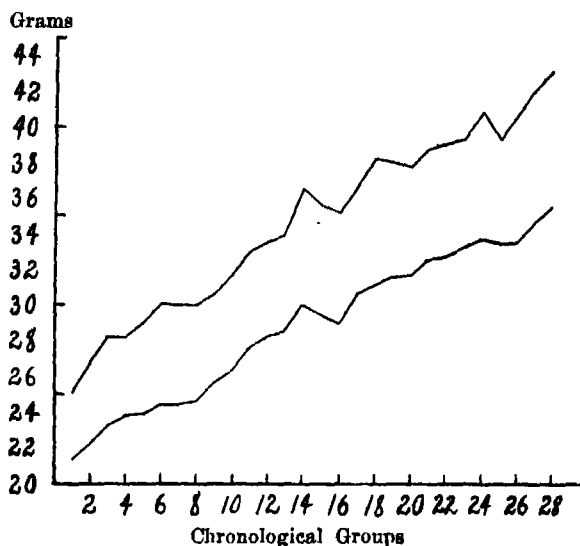


FIG. 1. The upper line shows the average weight of the mice arranged chronologically by groups of five hundred male numbers. The lower line shows female averages, but since females are more numerous than males, each female group, in order to synchronize with the corresponding male group, as a rule contains more than five hundred females. Since counts of the number of generations in the pedigrees of the mice of the last group correspond closely with the number of groups, a group may be taken as a generation, although the first group includes the first four generations and part of the fifth. Chronological groups are used because the number of generations in the ancestry of any individual mouse is not the same in the various possible ancestral lines.

An increase in the weight of the heaviest animals has also occurred. Thus the heaviest male in the last group weighs 54.3 grams as compared to 48.1 of the fourteenth group and 34.2 of the first group. The corresponding females' weights are 49.7, 41.0 and 28.6 grams, respectively (equivalent, on the average ratio of male and female weights, to males of 60.1, 49.6 and 34.6 grams, respectively), these weights being taken at the standard age of two months. Males weighing as much as 35.5 grams at one month of age—the weight of very large, full-grown albino males of the ordinary sort—have been recorded, and aged females have reached 87.5 grams. Thus the heaviest mice

<sup>1</sup> See the description of Fig. 1.

weigh nearly twice as much as the heaviest individuals of most strains of laboratory albino mice.

This experiment was designed in the first place to throw light on the amount of improvement which might be made in the productive qualities of farm animals. When it is realized that the number of parent mice—some 1,200 males and 6,000 females—in the entire twenty-eight generations is very small compared to the hundreds of thousands or even millions of each kind of farm animal mated every year in the United States of America, it would seem that by adding a small amount, perhaps one per cent., to the labor now required to maintain these animals, their productivity can be changed from a level suited to medieval times to a level befitting the twentieth century. If the attained increase in the average weight of the mice is taken as a guide in estimating possible improvement, average milk yield could be increased 70 per cent., horses could be 70 per cent. stronger or speedier, pigs grow 70 per cent. faster, with a corresponding amount of improvement in other animals.<sup>2</sup> We may even wonder what the world would be like if the brain power of the human race were to be increased in like proportion.

Progeny-test breeding of the kind used with the mice may also be applied to plants in numerous ways, such as the development of races adapted to conditions of life to which the parent race is ill adapted, more rapid growth or less rapid growth, indeed to any continuously varying character—not that it will replace other methods of breeding, such as hybridization, which are so effective for some purposes, but that it can be used for purposes to which other methods of breeding are inapplicable, with good prospects of making progress in the desired direction.

The bearing of this work on evolution by means of natural selection is not found in the amount of change, which, after all, is not very large, or in the method of breeding which does not occur in nature in so far as known, but in providing evidence that organisms may be modified at a rate and to an extent that makes further studies along this line worth the necessary time and effort. The means seem to be at hand for accelerating the rate of change which Darwin and his followers supposed occurred in nature at a very slow rate—too slow, indeed, to be observed in short periods of time. Progeny-test breeding, by accelerating the rate of change, offers a means of studying this aspect of evolution experimentally.

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<sup>2</sup> Progeny-test breeding of poultry, under well-controlled conditions, by increasing egg yield by similar amounts, is another demonstration of the possibilities in progeny-test breeding.

# ENZYMES IN ONTOGENESIS (ORTHOP- TERA). XVII. THE IMPORTANCE OF COPPER FOR PRO- TYROSINASE<sup>1</sup>

An inactive tyrosinase or protyrosinase yields a tyrosinase which can be poisoned by carbon monoxide, cyanide and diethyldithiocarbamate. The occurrence of copper in this protyrosinase is thus a reasonable expectation. The purpose of this paper is to test the effects on protyrosinase of the removal and subsequent addition of copper.

Protyrosinase was extracted from eggs of a grasshopper, *Melanoplus differentialis* (Thomas), according to a previously described method.<sup>2</sup> Its tyrosinase activity was measured in a Warburg apparatus. Aerosol, a commercially available synthetic detergent, was added in such excess that any protyrosinase was activated or converted into tyrosinase.

The procedure employed for removing copper from the protyrosinase was similar to that used by Kubowitz in studies of polyphenol oxidase.<sup>3</sup> An excess of potassium cyanide, 5 cc of .01 M KCN, was mixed with 20 cc of the protyrosinase extract. After a half hour 100 cc of saturated ammonium sulfate was added. The precipitate was centrifuged down, washed with 25 cc of saturated ammonium sulfate 0.05 M with respect to potassium cyanide, and dissolved in 0.9 per cent. sodium chloride. This solution was removed to a Cellophane tube and dialyzed against 0.9 per cent. sodium chloride for 50 hours at 0° C. A similar volume of protyrosinase extract received the identical treatment except that sodium chloride was substituted for potassium cyanide. The latter solution served as a control for the extraction of copper. After dialysis the volume of each of the two solutions was brought to 28 cc.

The copper content was estimated by means of a recently described method.<sup>4, 5</sup> A solution of copper sulfate in 0.9 per cent. sodium chloride was used as a source of copper. The total concentration of copper in the Warburg vessels is expressed in terms of moles per liter of reaction fluid (volume equals 3.0 cc).

The results of the treatment with potassium cyanide can be compared in terms of the change in amount of copper. During precipitation and dialysis the control protyrosinase preparation must have lost very little copper, since its  $4.7 \times 10^{-8}$  M represents a 98 per cent. recovery. Only one fifth as much,  $0.9 \times 10^{-8}$  M, remained in the extract treated with cyanide.

<sup>1</sup> Aided by a grant from the Rockefeller Foundation for research in cellular physiology.

<sup>2</sup> T. H. Allen and J. H. Bodine, *Proc. Nat. Acad. Sci.* (in press), 1941.

<sup>3</sup> F. Kubowitz, *Biochem. Zeitschr.*, 299: 32, 1938.

<sup>4</sup> A. Eden and H. H. Green, *Biochem. Jour.*, 34: 1202, 1940.

<sup>5</sup> The analyses were performed by E. B. Newell.

The removal of copper apparently produces a decrease in protyrosinase which can be restored by the addition of a copper salt (Fig. 1). In agreement

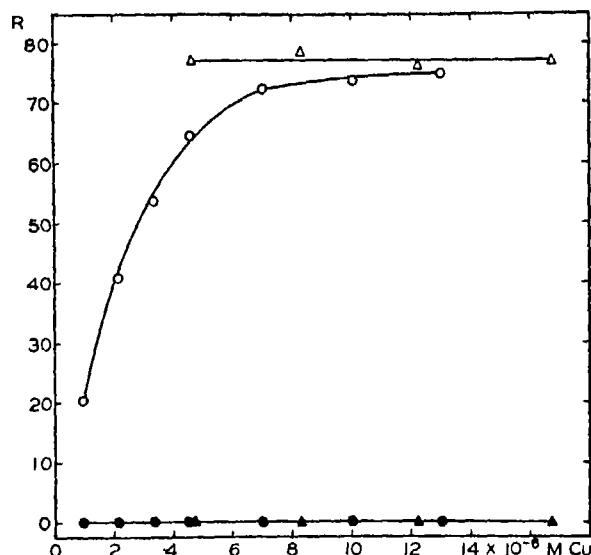


FIG. 1. Resynthesis of protyrosinase. Ordinate, reciprocal  $\times 10^4$  of the time in minutes for the initial uptake of 100 c.mm. of oxygen during the oxidation of  $6.9 \times 10^{-3}$  mM of tyramine catalyzed by tyrosinase from 0.3 c.c. of protyrosinase extract. Abscissa, total concentration of copper. Open symbols, 0.07% Aerosol; closed symbols, no Aerosol. Circles, extract from which copper was removed; deltas, extract from which no copper was removed. pH = 6.8; Temp. = 24.9°C.

with Kubowitz<sup>3</sup> it was found that salts of Fe, Co, Ni, Mn and Zn were unable to replace those of Cu. The protyrosinase yields a tyrosinase which seems to be specifically dependent on copper for its enzymic activity. An excess of activator, Aerosol in this instance, seems to be necessary for conversion of protyrosinase into tyrosinase (Fig. 1). It is worthy of note that twice as much copper, that is  $10$  rather than  $5 \times 10^{-6}$  M, needs to be present for complete restoration of protyrosinase. The resynthesized protyrosinase and tyrosinase are destroyed by heating at  $90^\circ$  for 5 minutes;  $18 \times 10^{-6}$  M copper sulfate and the same with an excess of Aerosol have no catalytic activity. Thus it seems that copper unites with a copper-free substance to give a thermolabile protyrosinase, which in its turn must be activated before a thermolabile tyrosinase is produced. An anomalous and differential heat effect has also been found for protyrosinase extracts of low copper content, i.e., heat treatment between temperatures of  $60^\circ$  and  $70^\circ$  not only inhibited but also activated.<sup>4</sup> The heat

effects, therefore, appear to be independent of the copper.

Although the potentially active group of protyrosinase reacts with cyanide, it is unable to activate the enzymic oxidation of substrates. With the present knowledge of protyrosinase it seems hazardous to choose between whether the activation of protyrosinase is primary and direct or secondary and perhaps concerned with the removal of some material surrounding a core of tyrosinase. If the latter were so, it may be pointed out that the shell must be permeable to cyanide and its copper compound yet impermeable to substrates. This kind of semi-permeability would seem to be of a very peculiar order. Since Kubowitz<sup>3</sup> has shown that the active group of polyphenol oxidase indulges in electron exchange in order to catalyze the substrate's oxidation, it is suggested that a difference between protyrosinase and tyrosinase may be concerned with the state of its copper. An activator presumably overcomes some hindrance to oxidation and reduction of the active group.

When its copper is partially removed, a protyrosinase extract yields less tyrosinase. The return of copper leads to resynthesis of protyrosinase. The copper of protyrosinase seems to be a potentially active, prosthetic group.

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### THE USE OF FATTY ACIDS IN INSECTICIDAL AEROSOLS

IN recent investigations<sup>1</sup> it has been shown that some relatively nonvolatile compounds show promise as fumigants against insects when applied in smoke or fog form. This development makes possible the use of safe and inexpensive insecticides that were formerly considered impractical because of difficulties in producing effective concentrations at room temperatures.

In practice a solution of the insecticidal material was sprayed on a heated surface. On coming in contact with the hot surface, the solvent was evaporated with explosive violence, and any dissolved material that did not vaporize readily was reduced mechanically to colloidal dimensions. That is, the insecticide was dispersed as an aerosol consisting of a suspension of the solid or liquid particles in air. By this method of volatilizing it was possible to keep the insecticide dispersed in an enclosed space for a long time. The rate of evaporation was also greatly increased, and the maximum vapor concentration was quickly obtained because of the tremendous surface of these

<sup>4</sup> J. H. Bodine and T. H. Allen, *Jour. Cell. and Comp. Physiol.*, 12: 71, 1938.

<sup>1</sup> W. N. Sullivan, L. D. Goodhue and J. H. Fales, *Soap*, 16 (6): 121, 123, 125, illus. 1940.

TABLE 1  
RELATIVE EFFECTIVENESS AGAINST HOUSEFLIES OF ORTHODICHLOROBENZENE, ALONE AND IN COMBINATION WITH OLEIC AND LAURIC ACID, WHEN DISPERSED IN AEROSOL FORM; EXPOSURE PERIOD 30 MINUTES\*

Material tested	Number of insects tested	Mortality after 2 days, per cent
Orthodichlorobenzene .....	609	2
Orthodichlorobenzene plus oleic acid .....	440	55
Orthodichlorobenzene plus lauric acid .....	471	60
Lauric acid .....	216	1
Oleic acid .....	220	1

\* Orthodichlorobenzene was used at the rate of 0.28 cc per cubic foot and the fatty acid at 0.071 gram per cubic foot.

This method of producing an aerocolloidal dispersion by spraying liquid toxins on a heated surface might be of use to bacteriologists, who have found bacteriocidal aerosols effective in decontaminating rooms.<sup>2</sup>

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and increase the toxicity of these insecticides, fatty acids (lauric or oleic) were used in a spray solution. It was shown with bioassays against the housefly that these materials increased the effectiveness of orthodichlorobenzene. The results of these tests are given in Table 1.

Lauric and oleic acids are substantially effective when used alone, under the conditions of these tests. They act as adjuvants when combined with orthodichlorobenzene and greatly increase the effectiveness of the aerosol. Certain fatty acid derivatives, such as esters, esters, and the like, also gave increased insecticidal action. The results were corroborated by room tests against the roach and the bedbug, where a 100 per cent. mortality was obtained by using 1.5 pounds of orthodichlorobenzene containing 5 per cent. of lauric acid per 1,000 cubic feet.

## SCIENTIFIC APPARATUS AND LABORATORY METHODS

### A BUBBLER PUMP METHOD FOR QUANTITATIVE ESTIMATIONS OF BACTERIA IN THE AIR<sup>1</sup>

The bacterial content of the air of a rheumatic fever hospital has been studied regularly throughout the past winter. For quantitative estimations, an air centrifuge of the type described by Wells<sup>2</sup> was used and occasional runs were made with apparatus similar to that of Hollaender and Dalla Valle.<sup>3</sup> Results were so variable even in successive runs in an apparently stable environment that more refined methods of estimating the number of bacteria in air were sought. The most satisfactory machine in respect to efficiency and ease of operation was a modification of that described by Robertson,<sup>4</sup> Bigg, Miller and Baker in *SCIENCE*, February 28, 1941. This operated on the principle of the slow bubbling of air through liquid media. Glass beads serve to break up bubbles and release bacteria to the broth which might otherwise escape within the bubbles.

<sup>1</sup> From the Department of Preventive Medicine, Harvard Medical School, and House of the Good Samaritan, Boston, Massachusetts. This work was supported in part by a grant to the House of the Good Samaritan from the Commonwealth Fund.

<sup>2</sup> W. F. Wells, *Am. Jour. Pub. Health*, 23: 58, 1933.

<sup>3</sup> A. Hollaender and J. M. Dalla Valle, *Pub. Health Rep.*, 54: 574, 1939.

The apparatus shown in Fig. 1 consists of a sterile 250 cc Erlenmeyer suction flask containing a mea-

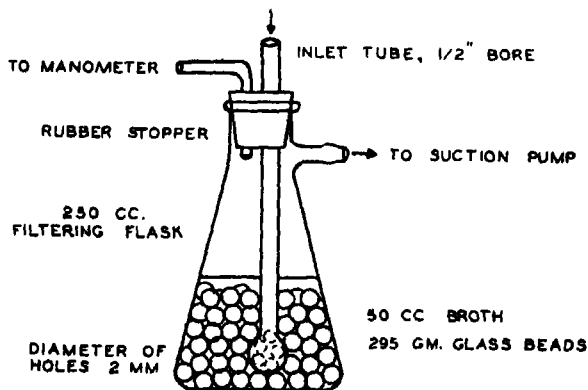


FIG. 1. Diagrammatic drawing of bubbler pump apparatus.

sured quantity of glass beads and broth. Air is drawn through this flask at rates indicated by a manometer at the inlet. At the completion of a minute run, one and two cc amounts are pipetted to sterile petri dishes and poured and mixed with the incubation medium.

<sup>2</sup> C. C. Twort, A. H. Baker, S. R. Jour. Hygiene, 40 (3): 253-344.

<sup>4</sup> O. H. Robertson, E. Bigg, B. F. *SCIENCE*, 93: 213 and 214, 1941.

cleaner motor provided sufficient suction for our purposes. Inlet tubes were specially constructed with one-half inch bore and with the submerged end a perforated bulb of the bubbler type to prevent clogging or unequal pressure from the glass beads.

Calibration of the air flow was determined by the displacement of air by water in a two-liter flask and checking these rates with differences in the manometer levels. Best results were obtained at relatively low rates indicated by the gentle bubbling of air through the broth and beads. Optimum speeds were between 3.6 and 9.0 liters per minute. Too strong suction tended to cause splashing and sucking of broth through the outlet of the flask. As in bacterial analysis of milk, the number of colonies found in plates poured with one and two cc samples of broth are multiplied to the number which should be present in the entire 50 cc. Immediate pour plates of the broth are not necessary since significant bacterial growth does not take place for an hour or more even at room temperature. However, if immediate pouring is not practical it is advisable to store the flasks in the refrigerator. Colony counts of samples ranging from 0.5 cc to 3 cc reveal a straight line relationship of size of sample to number of colonies.

Tests on the efficiency of this machine by attaching it in series to the Wells Air Centrifuge, and tests where two of the bubbler pumps are set up so that the exhaust of one is attached to the inlet of the other reveal that bacteria of air samples are more thoroughly absorbed by the bubbler pump than the air centrifuge. Table 1 shows the magnitude of this difference in

TABLE 1  
RELATIVE EFFICIENCY OF THE BUBBLER PUMP AND AIR CENTRIFUGE AS SHOWN BY AIR SAMPLES FROM THE APPARATUS CONNECTED IN SERIES

Apparatus	Unit	Colony counts		Estimated colonies av. in 50 ml.	Count in 10 cu. ft.
		1 ml.	2 ml.		
(A) Two bubbler pump units in series.	Pump No. 1	5	8	225	990
	Pump No. 2	0	0	0	0
(B) Centrifuge in series to the outlet of the bubbler pump.	Pump	6	10	262	1,100
	Centrifuge	-	-	-	1

The above experiments were conducted in the same room on the same day.

units when the machines are arranged in separate runs are made in the same machines colony counts indicated by re usually several times that found uple of air from the centrifuge. protocols of such runs. eriments indicate that accurate terial content of air under the

Room	1 ml.	2 ml.	Av. count ml. br	Est.
Ward F ...	3	7	162	
Ward E ...	3	14	318	1 1/2
Ward H ...	3	5	137	6
Room 63 ..	3	5	137	6

natural conditions of a hospital ward with these bubbler pumps. Experiments aress involving the correlation of dust an counts and the effect of ultra-violet rays on teria of irradiated rooms.

S. M. WHEELER  
G. E. FOLEY  
T. DUCKETT JO

### COIN MATS FOR THE MICROSCOPI

THE scarcity of supplies and the increase of cover glasses suggest greater care in those already on hand. It has been learned th breakage can be avoided by the use of a rub mat. Cover glasses and slides placed on th are easily grasped by the fingers without the of pushing them to the edge of the table, wh frequently break from pressure in trying to pi up, or fall to the floor. There is also a great on the finger nails and no risk of undernail f from rough tables. As a matter of fact, fin long or short, cease to be a factor in han cover glasses. Ease in mounting specimen cient reason for using the coin mat and t in breakage will soon amortize any expense

The coin mats may be obtained from the ber Company, Barberton, Ohio. Used whole or quartered, they furnish a simple conve frustrate an ever-present source of impatie.

LINUS H

MASSACHUSETTS STATE COLLEGE

### BOOKS RECEIVED

- DEXTER, LEWIS and SOMA WEISS. *Presol Eclamptic Toxemia of Pregnancy*. Pp. xvii figures. 3 plates. Little, Brown.
- FENN, WALLACE O., Editor. *Muscle; Vol. III Symposia*. Pp. 370. Jaques Cattell Pres Pa. \$3.50.
- GILBERT, NORMAN E. *Electricity and Magne and Applications*. Second edition, revised 585. 394 figures. Macmillan. \$4.50.
- MEYER, BERNARD S. and DONALD B. ANDERS *tory Plant Physiology*. Second edition. illustrated. Van Nostrand. \$2.00.
- MILHAM, WILLIS I. *Time and Timekeep* 616. 339 figures. Macmillan. \$1.98.

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## THE TRANSITION FROM THE INDIVIDUAL TO THE SOCIAL LEVEL<sup>1</sup>

By Professor H. S. JENNINGS

THE UNIVERSITY OF CALIFORNIA AT LOS ANGELES

THE self-sustaining biological individual in its most elementary, non-social condition is seen in the free single cell. I shall deal with such free single cells, known as Protozoa, and shall try to trace the various directions in which there is transition in their activities from the individual to the social level. I shall deal mainly with those Protozoa which are known as ciliate infusoria.

As criteria of social action several points or relations are distinguishable. First, in any grouping of organisms, are the individuals influencing each other?

<sup>1</sup> Symposium on "Levels of Integration in Biological and Social Systems. Group or Population Aspects," University of Chicago, Tuesday, September 23.

Second and perhaps more important is the question of the functional value of the relations of the individuals: are there relations of mutual benefit, of co-operation in the performance of necessary biological activities? (In some cases the functional value is negative; the individuals harm each other.)

Third is the question of functional differentiation, of division of labor among individuals that are reaching socially. This is perhaps equivalent to the question whether there exists social organization. Only if the individuals play different functional roles is there social organization.

Social behavior commonly manifests itself in the

aggregation of individuals, or sometimes in its opposite, dispersal; in the fact that the individuals of a species tend, for whatever cause, to remain together; or that they tend to separate.

A free cell, such as the infusorian *Paramecium*, without companions and without aid performs the fundamental activities of life; those connected with nutrition; movements and reactions, reproduction.

One of the fundamental activities relieves it of its solitary condition. It reproduces, it divides into two. Each of the two divides, and this continues till many individuals are present.

But the world is wide; such individuals may separate, exercising no influence on each other. In many cases they do separate widely, each remaining at the individual level.

On the other hand, in some cases division of the individuals is incomplete, so that the individuals remain materially connected, forming what is called a colony. Development in this direction is to be treated by another speaker in this symposium; I shall therefore not pursue it, but deal with social relations only among individuals that separate completely, remaining free.

Such free individuals may influence each other in various ways. One of the most fundamental of these relations lies in the fact that they affect each other's reproductive processes. When two or several individuals are together, each may reproduce by division more rapidly than does the single individual alone. A functional relation has arisen, a social relation of mutual benefit.

Such phenomena were first described by Robertson in 1921. He made observations which, he believed, prove that in some species of infusoria multiplication occurs more rapidly when other individuals of the species are present. It seemed that the individuals must secrete materials which pass into the water and stimulate other individuals to reproduce. This phenomenon Robertson called the allelocatalytic reaction.

Some later investigations have failed to confirm the occurrence of such effects. Others supported the views of Robertson<sup>2</sup> (see the reviews of investigations in this field by Allee<sup>3</sup>). The great complexity of the biological environment in Protozoa makes difficult the attainment of concordant results in this field. Changing one factor in the environment changes others, so that the results of a single changed factor can be known only with great difficulty. Also it is possible or probable that different species differ in these phenomena.

But the recent critical investigations of Mast and

Pace<sup>4</sup> and of Kidder,<sup>5</sup> making use of sterile cultures, yield the conclusion that in the organisms studied (*Chilomonas* and *Tetrahymena*) the so-called allelocatalytic effects are real. The organisms named are shown to modify the medium in which they live in such a way as to cause somewhat more rapid multiplication in individuals of their own kind that are present. When, however, the number of individuals in the medium becomes very great, the rate of multiplication is decreased instead of increased. How generally such phenomena occur in Protozoa is not yet known. There are strong indications that in some other infusoria similar effects are produced in a less direct way.

So far as this method of action occurs, it lends significance to the aggregations of individuals, however these aggregations are produced. When many individuals of a species are gathered together they promote each other's reproductive processes; they cause the species to increase and multiply; or in some cases they have the opposite effect.

We must therefore examine the phenomena of aggregation in our infusoria. Aggregations are produced in many ways.

One method is through common reactions to given stimuli. The free individuals produced by division of a single parent are alike, in their structure and in their physiology. Therefore they react in the same way to outer agents. In some species all swim toward a source of light. In an electric current all swim toward the cathode. All may tend to move against the force of gravity. In most species, all the individuals tend to bring their bodies into the fullest possible contact with small solid objects. These common reactions tend to keep the cells together; they produce aggregations. Protozoa of a given species may often be collected in thousands by allowing the light to fall on them from one side, or by passing an electric current through the fluid in which they swim, or by so placing them that their relation to the pull of gravity is constant. The cells then form dense aggregations. In these aggregations there is no integration save the common reaction to an outer agent. There is no differentiation of function among the individuals, no division of labor, no organization. Of mutual influence there is only the increased or decreased tendency to multiplication, resulting from the presence of many individuals together. Possibly also this coming together through a common reaction presents an opportunity for social organization to arise.

At a similar low level are aggregations which are produced as a result of the fact that the conditions for multiplication are the same for all the members of the species. Where nutritive conditions are good,

<sup>2</sup> T. B. Robertson, *Biochem. Jour.*, 15: 612-19, 1921.

<sup>3</sup> W. C. Allee, "Animal Aggregations," 431 pp., Chicago, 1931; *Biol. Reviews* (Cambridge), 9: 1-48, 1934; "The Social Life of Animals," 203 pp., New York, 1938.

<sup>4</sup> S. O. Mast and D. M. Pace, *Physiol. Zool.*, 11: 359-82, 1938.

<sup>5</sup> G. W. Kidder, *Physiol. Zool.*, 14: 209-26, 1941.

multiplication occurs, so that dense aggregations are formed. Such nutritive aggregations are exemplified by the multitudes of parasitic Protozoa found within the body of the host. In these nutritive aggregations there need be no functional differentiation of individuals, hence nothing resembling a social organization.

Returning to the aggregations resulting from motor reactions, one may observe in these a step forward, in that the individuals begin to react to each other, even to cling together. At the lowest level the individuals react to each other merely as to other physical masses. As before remarked, in many infusoria the individuals react to any small loose bodies, such as bits of filter paper, by placing themselves as fully as possible in contact with them. The infusoria are themselves small loose bodies, so that they react in this way to each other. On touching they may remain in contact, forming small dense aggregations. In these aggregations there is still no functional differentiation, no division of labor, no social organization. Though the individuals react to each other, each one plays toward the others merely the role of a small solid object.

In some of the Protozoa—particularly in the ciliate infusoria—this reaction of individuals to each other reaches a higher development, which is of a striking character. The reaction to other individuals becomes specialized, both in its object and in its character. Two individuals that happen to touch remain in contact and move together in a coordinated manner. They swim off in a coordinated motion side by side, proceeding in a graceful spiral through the water. "They may keep this up for but a few seconds, then separate, or may continue it for a much longer time, leading finally to a mating of the two. Most often, however, this caressing behavior lasts but a few moments, then the two individuals separate—possibly coming together again in a similar way a few seconds later."<sup>6</sup> This type of behavior has perhaps implications that are much higher than those of the behavior thus far described. It plays a role in the processes of mating, which are to be described later.

Now comes a more advanced stage of development. The individuals in many species react to each other's chemical properties, and they react in a specific way, such as keeps them together. Chemicals of certain sorts diffuse from their bodies into the water, inducing in other individuals reactions that give rise to close aggregations.

This is a great step in advance. Through it the individuals react to each other without actual contact; they react at a distance. It provides some of the most

striking phenomena in the life of single-cell organisms. Many infusoria, such as various species of *Paramecium*, produce a secretion that is of a faintly acid reaction. This secretion diffuses from the individuals into the water, forming a zone of faintly acid solution. Other individuals coming into this acid zone swim about within it, but refuse to leave it. On coming to its boundary—to a region of marked decrease in acidity—they turn back. They perform what I called in my early work the "avoiding reaction," and this results in their remaining within the acid region. Every individual that comes into the acid region refuses to leave it, so that an aggregation is formed. And the more individuals there are present, of course the more pronounced becomes the acid reaction resulting from their secretions. The effectiveness of the material therefore becomes greater, so that the aggregation of individuals becomes continually denser and larger.

The aggregation is the result of negative reactions. The animals do not react when outside the region of acid, nor do they react when they enter it. But they do react when they arrive at a boundary at which they would leave. Here they react negatively, so as to remain. The dense aggregation thus results from negative reactions.

In *Paramecium* and some other infusoria the secretion which acts in this way appears to be carbon dioxide. If a bubble of carbon dioxide is introduced into water containing the organisms, they form an aggregation about it just as they do in the groups that are spontaneously formed. We know independently, of course, that the cells produce carbon dioxide in their respiratory processes. Also, chemical indicators show that the water in which the spontaneous aggregations occur has such a degree of acidity as would be induced by the presence of a small amount of dissolved carbon dioxide. The evidence is strong that carbon dioxide is the active agent in producing the spontaneous aggregations. They likewise collect in other weak acids.

In some other species of infusoria other secretions are produced, which likewise cause aggregations. The cells of these species will not aggregate in the secretions from *Paramecium*, nor in solutions of carbon dioxide. And *Paramecia* will not gather in the aggregations formed by these other species. Thus different kinds of cells have specific secretions, which induce aggregation in the species that produce them, but not in other species. For details of all these reactions, my early book (1906)<sup>7</sup> may be consulted.

In the production of such aggregations, then, the individuals influence each other. They are themselves

<sup>6</sup> H. S. Jennings, *Science*, 92: 539-46, 1940. Also: Leidy memorial lecture, 17 pp., The University of Pennsylvania Press, 1941.

<sup>7</sup> H. S. Jennings, "Behavior of the Lower Organisms," 366 pp., New York, 1906.

the agents in producing the aggregations. But nothing is known as to any functional value of these aggregations, of any reciprocal benefits to the individuals, save for the probability, already discussed, that by remaining associated in groups, they influence each other's rate of multiplication. Also, there is no differentiation of function among the individuals, no division of labor; thus no social organization.

In my youth I had certain adventures with these striking aggregations. Led by the considerations just mentioned, I plumped for the conclusion that these are not social phenomena. For this conclusion there fell upon me one of those philosophers who sum up wisdom in the maxim that "Everything is true of everything." Professor A. H. Lloyd cited my conclusion as a crass example of the failure of men of science to perceive what is under their noses. These phenomena, from his point of view are the social phenomena of infusoria. The analysis of the behavior into its elements and the discovery of the agents that bring it about do not alter the fact of the social nature of the behavior; they merely define the character of social behavior in these organisms.

There was perhaps justification for this criticism. These phenomena may be considered one of the lowest stages in social behavior, though hardly in social organization. And social organization actually does exist in these organisms; to this I shall come presently.

We have to this point dealt with (1) aggregations formed through common reactions to external conditions, though the organisms do not influence each other; (2) with cases in which the individuals influence each other, through the production of secretions that form solutions in the water, and that result (in some cases at least) in the formation of aggregations of many individuals. In some cases the mutual influence is of functional value, in other cases this is not known to be the case. In none of these cases is there differentiation of function among the individuals, so that there is no social organization.

A genuine social organization with differentiation of functions does however occur in the infusoria. In connection with what we may call family relations, functional differentiations appear among the individuals, and there is consequently a more or less complex social organization.

I have recently given accounts of the principal features of this organization<sup>6,8</sup> so that I shall here limit myself to an outline of its conspicuous features.

<sup>6</sup> H. S. Jennings, *Genetics*, 24: 202-33, 1939; *Am. Nat.*, 73: 385-89 and 414-31, 1939. Also in: *Biological Symposia*, Vol. 1, 1940, pp. 117-21 and 145-63. See also: "Inheritance in Protozoa," Chapter 15 in "Protozoa in Biological Research," edited by Calkins and Summers, pp. 710-71. "Genetics of *Paramecium bursaria*, II. Self-differentiation and Self-fertilization of Clones." To be published in *Proc. Amer. Philos. Soc.* "Genetics of

In the biparental reproduction of the ciliate and flagellate infusoria, two individuals partly or completely unite, and from these are descended by fission a new set of vegetative generations. In the flagellates the two individuals coalesce into a single zygote, and the zygote produces the new vegetative generations. In the ciliates the two individuals, which we shall call the parents, do not completely coalesce, but become incompletely united and while in this condition exchange halves of their genetic or hereditary materials—their chromosomes; then the two separate. Thus each individual fertilizes the other. After separation each is a new combination of chromosomes, and each now multiplies in the usual way by fission—the new generations receiving half of their chromosomes from each of the two parents (the two conjugants). It is in connection with these processes that social organization has arisen.

It turns out that the two individuals which mate are differentiated, somewhat as the two sexes are differentiated in higher organisms. In the Protozoa, however, the differentiation is physiological, not, so far as one can see, structural. In the flagellates so far as studied (in the work of Moewus<sup>9</sup> and others), and in some of the ciliates, there are in any species or variety just two types that mate together, as there are two sexes in higher organisms. In some other species of ciliates there are more than two of these mating or sex types. In *Paramecium bursaria*, of which I have made a special study, there are in some varieties four mating types, in another variety there are eight. Individuals that are of the same sex type do not mate together. But individuals that belong to one of the sex types may mate with individuals of any other sex type. So in the flagellates, and in those ciliates in which there are but two sex types, A and B, every pair of mates consists of one A and one B. But in the species with four sex types, A, B, C and D, pairs may consist of A × B, A × C, A × D, B × C, B × D, or C × D, so that six different kinds of matings are possible. In that variety in which there are eight sex types, twenty-eight different kinds of matings may and do occur.

The actual process of mating is spectacular. When stocks of two different sex types are mingled together by mixing the cultures in which they are found, there is a sudden and strong reaction. The individuals of different sex type cling together. Several individuals of one sex type may cling to one individual of the other sex type. These are joined by other individuals of both types. In this way tight groups or clots are quickly formed, many individuals of the two types

*Paramecium bursaria*, III. Inheritance of Mating Type, in Crosses and in Clonal Self-fertilization." To be published in *Genetics*.

<sup>9</sup> F. Moewus, *Jahrb. f. wiss. Bot.*, 86: 753-83, 1938.

clinging together as if their bodies were covered with glue. They thus form masses of dozens or hundreds of individuals. (The formation and growth of these masses were shown in photographs projected on the screen.)

In the clotted masses the individuals adhere firmly together as if covered by some adhesive material. The clinging together is not an active or motor reaction, nor is it brought about by organs of attachment. It appears to be a physical adhesion; any part of the body of one individual thus adheres to any part of the individual of the other sex type. Often an individual visibly struggles as if trying to escape from the attachment to another individual, but in vain.

The great clotted masses remain thus with the component individuals stuck irregularly together for some hours. Then they begin to break up into smaller clots and often into chains of individuals attached end to end. This breaking up continues for two or three hours, the clots becoming smaller, until there remain only groups of two.

Thus in the course of this long and irregular adhesion the individuals of the two sex types have paired off, so that now almost all the individuals are in pairs. In every case the two individuals of any pair are members of the two different sex types. This is easily demonstrated when the individuals of the two different sex types differ in color or in other ways, as is often the case. It is further true that at any stage in the reaction, it is only members of two different sex types that adhere together; members of the same sex type show no tendency toward adherence.

The two mates remain intimately united for twenty-four to thirty-six hours, during which time they exchange halves of their chromosomes. They then separate and each begins to multiply by fission. (This description is from Jennings, 1940,<sup>9</sup> with verbal alterations.)

In forming these aggregations therefore the individuals of the different sex types react to each other as individuals, not merely to physical forces or to masses or chemicals present in the environment. The individuals are functionally differentiated, react selectively; and the reactions are highly functional, resulting in bisexual reproduction and the phenomena of inheritance from two parents.

In this mating behavior a part is played by the contact reactions of individuals to each other, previously described. Two individuals that come in contact react by swimming together for some distance. If they belong to different sex types (of the same variety), the contact passes into adhesion, so that the two individuals mate and complete the processes of conjugation. But if they belong to different sex types, they separate after swimming together for a time.

The contact reaction appears to have the function of a trial; if the individuals in contact are appropriate mates they unite in conjugation; otherwise they do not.

The differences between the different sex types appear to be of a chemical nature. Moewus<sup>9</sup> has seemingly demonstrated this for the two different sex types of certain flagellates, and has determined the nature of the chemical materials characteristic for each type; they are differing carotinoids. (For a general account of sex types and their physiology, see the résumé by Sonneborn.<sup>10</sup>) The conditions found in the ciliates are such as to suggest similar chemical differences in this group. The phenomena indicate that the materials characteristic for each sex type do not diffuse into the water, so that actual contact of individuals is necessary for inducing the typical mating phenomena. The chemical effects are thus surface phenomena.

Besides this differentiation into sex types, the individuals of any species may be differentiated into a number of different groups or varieties. Each group or variety has its own set of sex types, but the members of different varieties never mate together, so that the varieties remain distinct. In *Paramecium aurelia*, Sonneborn<sup>10</sup> finds three different groups, each with two sex types, but the groups never intercross. In some cases indeed members of the different groups are physiologically antagonistic, so that contact between members of different groups results in injury or death. We have here an example of negative social reaction; relations of mutual injuriousness between certain members of the same species.

In *Paramecium bursaria* there are likewise three varieties which never intercross. Two of these varieties have each four different sex types, while the third has eight. The system of possible matings is therefore complex. There are sixteen different sex types in the species as a whole; these mate together in accordance with the rules above set forth.

The social organization in these creatures is further complicated by the conditions of youth, maturity and age, and by the phenomena of inheritance. In *Paramecium bursaria*, after mating has occurred each of the two parents (the two ex-conjugants) produces a series of vegetative generations. The entire set of individuals, of many successive generations, produced by a single parent, may be called a clone. Each clone lives for thousands of vegetative generations, throughout several years. We may distinguish in each clone a period when it is young, when it is middle-aged, when it is old. In each of these periods the clone consists of great numbers of cells, like the body of a higher

<sup>9</sup> Moewus, *Jahrb. f. wiss. Bot.*, 86: 753-83, 1938.

<sup>10</sup> T. M. Sonneborn, "Sexuality in Unicellular Organisms," Chapter 14 in "Protozoa in Biological Research," edited by Calkins and Summers, pp. 666-709, 1941.

animal, but in the infusorian the clone is formed of separate cells, scattered in different regions.

Immediately after mating has occurred the clones produced by fission of the two parents are immature. The individuals of which the clones are formed do not react sexually at all; do not mate. This period of sexual immaturity or youth lasts for many generations, extending through months or in some cases even years. During this period of immaturity it is not possible to distinguish different sex types, since there are no sexual reactions.

After a long period, some of the individuals of the young clone begin to show a slight tendency toward mating. This period of weak and scattered sexual reactions might be called adolescence. It continues for many vegetative generations, through some weeks or longer, the tendency toward sex reactions gradually increasing.

Finally the cells of the clone become fully mature. Their sexual reactions are then immediate and strong (for an account of the striking phenomena in these reactions, see Jennings<sup>8</sup> or Sonneborn.<sup>10</sup>) At this stage it is possible to distinguish the different sex types, and to examine the relations between the sex types of the parents and of the clones that descend from them; that is, to study the rules of inheritance of the sex types. We now find that all the individuals of any clone are of the same sex type and indeed that all the individuals of the two clones descended from the two parents that form a pair are of the same sex type. But different pairs of the same cross produce clones of different sex type. By crossing many individuals of two clones, one of sex type A, the other of sex type D, we obtain among the descendants clones of all the four different sex types, while certain other crosses produced only three of the four sex types (for details, see Jennings, "Genetics of *Paramecium bursaria*," III).

The condition of maturity, with its differentiation into sex types, lasts for several years—during which time each original parent has produced through fission millions of individuals, all of the same sex type, and all equally mature.

But now, as in higher organisms, all this becomes changed through the phenomena of aging. The first indication of this lies in the fact that the individuals of old clones no longer produce vigorous young when they mate. Many of the young die. A period arrives in which conjugation results in the immediate death of all the individuals that mate; or in death of all descendants after two or three fissions or less. In this later period if a young and vigorous clone is mated with the old one, this means death to all descendants of either parent.

The effects of aging become later still more pro-

nounced. The very old clone no longer reproduces vigorously even by fission; multiplication takes place only very slowly. Many of the individuals die. The clone can be kept alive only with great difficulty. Finally, in spite of all efforts to keep it alive, all the individuals that belong to it die. The old clone has become extinct.

This account of youth, maturity, age and death is based on what occurs in *Paramecium bursaria*. In some other infusoria, notably in other species of *Paramecium*, the conditions appear to be very different from those just described. The period of youth or immaturity is in *Paramecium aurelia* very short, lasting but a few days (Sonneborn<sup>10</sup>). There is seemingly in these other species no aging. *Paramecium aurelia* and *Paramecium caudatum* may be kept alive, and reproducing vigorously by fission for an indefinite period.<sup>11</sup> Whether mating continues to produce vigorous offspring in late age in these species seems not to have been determined.

The conditions as to aging and death in *Paramecium bursaria* agree with the earlier accounts given by Maupas<sup>12</sup> for a number of species of ciliate infusoria, and by Calkins<sup>13</sup> for *Uroleptus mobilis*. The nature and causes of the age changes are uncertain, but the facts as to decline in vigor and inability to continue biparental reproduction are clear. The change may be the result of living for long periods in unnatural conditions in the laboratory; or it may be of the same sort as senescence in higher organisms (whatever that essentially is).

Thus in the life of the infusoria the clone may be considered the unit, as the individual body is the unit in higher organisms. Both the clone and the body are composed of many cells; both show periods of youth, adolescence, maturity and age. In both, all the cells are normally of a particular sex type; and different clones, like different bodies, are of diverse sex types. The clone is like a body in which the component cells do not remain together, but are scattered in space and time.

The differentiations in the social system of the infusorian are based upon mating and reproduction. There appears to be nothing corresponding to the industrial organization so conspicuous in some of the higher organisms, such as in the ants, bees and man. The system is more comparable to what has been called "Society with a capital S," than to the division of labor in carrying on the work of the species.

To sum up, we find that a natural population of

<sup>11</sup> H. S. Jennings, *Bibliographia genetica*, 5: 105-330, 1929.

<sup>12</sup> E. Maupas, *Arch. d. Zool. Exp. et Gén.* (2), 6: 165-277, 1888.

<sup>13</sup> G. N. Calkins, *Jour. Exp. Zool.*, 29: 121-56, 1919; *Jour. Exp. Zool.*, 31: 287-305, 1920.

such a unicellular organism as *Paramecium bursaria* shows in connection with reproduction a considerable degree of differentiation and social organization. There are young immature clones, adolescents, sexually mature clones reproducing vigorously, and aged clones that no longer reproduce successfully, and that finally die. Among the mature clones, we may find representatives of the three different groups or varieties, and of the sixteen different sex types that constitute the three varieties. That is, the individuals are functionally differentiated, and react to each other in a highly selective way. In these respects the social

system is complex, resembling that in some of the higher animals. The social organization connected with family life is of such a type as to form a natural step in the evolution of social systems, suggesting a unity throughout the world of organisms in respect to these matters.

To summarize the whole, we find that the transition from the individual to the social level begins in the one-cell organisms; and advances there by several steps. In connection with reproduction and development there has arisen a social organization of a considerable degree of complexity.

## OBITUARY

### JOHN STANLEY PLASKETT 1865-1941

WITH the passing of Dr. J. S. Plaskett, who died at his home in Victoria, B. C., on October 17 of this year, the astronomical world loses another of the men who were responsible for the rise of modern astronomy. Canada loses in him the leader who secured for her a prominent position in the astronomical world of to-day.

Dr. Plaskett was born on November 17, 1865, near Woodstock, Ontario. The financial resources of his family were meager, and for this reason Plaskett did not complete the work for the bachelor's degree until 1899, when he graduated from the University of Toronto. Plaskett was first an engineer in his home town of Woodstock and later for the Edison Electric Company, and for thirteen years he was an assistant in physics at Toronto. In 1903 he went as a mechanical superintendent to the Dominion Observatory in Ottawa, where he attracted the attention of Dr. W. F. King, the government astronomer of that time, and in 1905 he was appointed as director of the newly established astrophysical division of the Dominion Observatory at Ottawa. Plaskett entered upon his astronomical career at the age of forty.

During the eight years at Ottawa Plaskett's star rose rapidly. His proficiency in the adaption of the 15-inch refractor at Ottawa for spectroscopic research showed him to be one of the foremost designers of astronomical instruments. Through a careful design of the spectroscopic attachments Plaskett was able to photograph the spectra of unusually faint stars with the relatively small Ottawa refractor. The program for the measurement of stellar radial velocities which was initiated at Ottawa dealt especially with eclipsing binaries. During this same period Plaskett studied the rotation of the sun by spectroscopic means.

It was not long after his appointment at Ottawa that Plaskett began to feel keenly the need for a larger and more powerful telescope to carry on his spectro-

scopic researches. He discussed his needs with the chief astronomer, Dr. King, with whose strong support the project of a large reflector on Canadian soil was presented to the Canadian government. In 1913 the government placed Plaskett in charge of the development of the plans for a large reflector and soon the contracts were let for the mounting, the mirror and the optical work for a 72-inch reflector to be erected on Little Saanich Mountain near Victoria, B. C.

The mirror blank was poured at the St. Gobain works near Charleroi, Belgium, and the disk left Antwerp for the United States less than a week before the outbreak of World War I. The mounting was made by the Warner and Swasey Company of Cleveland and the optical work was performed by the Brashear Company of Pittsburgh. In the spring of 1918 the large telescope was put into operation. Because of his early training as an engineer, Plaskett was the ideal person to draw up the plans and supervise the erection of the 72-inch telescope.

Plaskett and his associates at the new Dominion Astrophysical Observatory lost no time in getting down to work. In a paper published in November, 1918, he writes:

The mirror arrived at the Observatory on April 29, the first spectrum was obtained on May 6, and in the measurement of some 750 spectra secured since that date, these twelve spectroscopic binaries have been discovered.

Plaskett was the director of the Dominion Astrophysical Observatory from its beginning until his retirement at the age of 70 in 1935. The Publications of the Observatory published under his directorate by himself and his associates, Harper, Young, H. H. Plaskett (his son), Pearce, Redman and Beals, are a lasting monument to his driving effort and insight in astronomical matters.

The measurement and interpretation of stellar radial velocities was the main purpose of the new observatory. In the course of time Plaskett touched upon almost every phase of radial velocity work. A

great deal of useful information was gathered about the masses of the eclipsing binaries. An incidental discovery was "Plaskett's star," a massive spectroscopic binary, with two component O-type stars, having a total mass of more than 100 times that of our sun.

Largely under the influence of his son, H. H. Plaskett, the elder Plaskett became in the early nineteen-twenties very much interested in the problems of O-type stars. In a masterful paper published in 1924 Plaskett presented the results of his researches about these extremely hot stars. This paper deals with a wide variety of topics related to O stars. Their spectral characteristics were examined with great care, and much new material was given on the masses, intrinsic brightnesses and motions.

Through the studies of early-type stars Plaskett soon became very much interested in the stationary lines from ionized calcium. Originally Slipher had suggested the interstellar origin of these lines, but to most workers around 1920 it seemed more likely that they were formed in the regions directly around the star. On the basis of his observations of radial velocities and intensities of the stationary H and K lines, Plaskett decided in favor of the interstellar origin. He writes in his paper of 1924:

The stellar and calcium velocities are generally greatly different, the former wandering all over while the latter do not differ greatly from the reflex of the solar motion. . . . A new hypothesis of widely extended, very tenuous clouds of calcium and sodium in which the star is situated and moving and which it excites and ionizes and so produces the sharp absorption line is developed.

It is hardly necessary to say that this hypothesis has been verified by subsequent studies. Plaskett became more and more interested in the interstellar gas and most of his subsequent papers contain useful information about further characteristics in the behavior of the interstellar lines.

In addition to the more glamorous type of work related to eclipsing binaries, O stars and the interstellar gas, Plaskett and his staff spent much of their time on a large routine program of the kind that forms the real backbone of modern astronomy. In cooperation with the Mount Wilson and Lick observatories, the astronomers at Victoria did their part toward completing the determination of the radial velocities for all stars in Boss' Preliminary General Catalogue of proper motions.

After the publication of a first general list, containing the radial velocities of nearly six hundred stars, Plaskett turned his attention more and more to the early-type stars. It was about this time that Oort and Lindblad advanced the theory of galactic rotation. Plaskett, who was very much impressed with this new development, saw immediately that his 72-inch reflector

was the ideal instrument to provide the radial velocities of faint and distant stars that would prove or disprove the theory.

From 1928 on Plaskett's papers, published in part jointly with Pearce, deal almost exclusively with problems related to the rotation of the galaxy. The first paper in the series appeared as early as 1928, and in several numbers of the *Victoria Publications* the subject is considered again. It may well be said that Plaskett's measurements of radial velocities of O and B stars and of the interstellar lines in their spectra provided a firm foundation for the theory of the rotation of the galaxy. During the last five years of his directorate Plaskett gave several formal addresses, among them the George Darwin lecture for the Royal Astronomical Society on the subject of "The High-Temperature Stars" and the Halley lecture at Oxford on "The Dimensions and Structure of the Galaxy." The topic of galactic rotation was considered in almost every one of these lectures.

Shortly after his retirement Plaskett was asked by the Warner and Swasey Company to serve as a consultant for the work on the 82-inch mirror of the McDonald Observatory. He served intermittently in this capacity from 1936 to 1938, and at the symposium for the dedication of the McDonald Observatory in the spring of 1939 Plaskett presented a paper about the new telescope and mirror.

During the last fifteen years many of the highest scientific honors came Dr. Plaskett's way. He received honorary degrees from leading Canadian universities, including his alma mater, Toronto, and from the University of Pittsburgh. Between 1932 and 1935 he received the Rumford Medal of the American Academy of Arts and Sciences, the Gold Medal of the Royal Astronomical Society, the Bruce Medal of the Astronomical Society of the Pacific, the Favelle Medal of the Royal Society of Canada and the Henry Draper Medal of the National Academy of Sciences. He was a commander of the Order of the British Empire.

Plaskett was a great traveler. In the early days of the Solar Union, Plaskett was active on several of its committees; he was the Canadian representative at the meeting in Germany in 1913. In his later years he was one of the leading figures in the International Astronomical Union. He was active on many committees of the I. A. U. and president of the committee on stellar radial velocities from 1932 to 1938. After a serious illness in the spring of 1928, he came on crutches to the meeting at Leiden; Plaskett wanted to attend the meetings, where he was very eager to discuss with Oort and Lindblad his projects for the study of galactic rotation, and no doctor was going to keep him in Canada!

Plaskett's temperament was well suited to the re-

sponsibilities and duties that came naturally with the directorship of a large observatory. But whereas heavy directorial duties weigh down many a good man they seemed in the case of Plaskett to stir him to greater and more intense activity. He frankly enjoyed the job and the freedom that it gave him. I shall always remember his saying, "As a director it is your privilege to ask advice from many people, consider all suggestions carefully and then do as you please."

It is impossible to appreciate J. S. Plaskett without considering his happy family relations. Mrs. Plaskett and his son Harry played a very important part in his life. Plaskett was a strong man who could on occasion be sharp and blunt, and he needed the sweetness and kindness of Mrs. Plaskett. I doubt whether any astronomer of the present generation will ever think of him without picturing his wife somewhere in the background, not very far away. The success of Harry H. Plaskett, who after some years at Victoria went to Harvard and from there as Savilian professor of astronomy to Oxford, meant a great deal to his father. Harry Plaskett was in no small measure the cause of his father's expanding his field of research from eclipsing binaries and routine radial velocities to include spectral studies and general research on stellar motions. In knowing the elder Plaskett we can not overlook the contributions made by his wife and son.

Plaskett's name will go down in astronomical history as that of a leading designer of astronomical instruments, an untiring contributor of basic observations and a keen analyst through whose work our knowledge of the galactic system and its component stars was greatly advanced. Above all, however, we shall remember Plaskett as the man who placed Canada among the leading nations in astronomical research. We expect of the Canadian astronomers,

present and future, that they carry on in the tradition established by Plaskett.

BART J. BOK

HARVARD COLLEGE OBSERVATORY

## DEATHS AND MEMORIALS

SIR ARTHUR WILLIAM HILL, since 1922 director of the Royal Botanical Gardens at Kew, was killed on November 3 when thrown from his horse while riding. He was sixty-six years old.

DR. JOHN ERIC WELIN, emeritus professor of chemistry and physics at Bethany College, Lindsborg, Kans., died on October 23. Dr. Welin was a native of Stockholm, Sweden. He was graduated from Augustana College and the University of Kansas. He served as a teacher at Bethany College beginning in the year 1891, and was elected emeritus professor in 1937.

A PLAQUE in memory of Dr. William North Rice, since 1918 professor emeritus of geology and natural history at Wesleyan University, three times acting president of the institution, was unveiled in Memorial Chapel on November 8. Dr. Rice died in 1928 at the age of eighty-four years.

AT noon on October 28, two-score friends of Dr. Robert Thomas Hill met at the foot of Round Mountain, seven miles west of Comanche, Texas, and after appropriate ceremonies, climbed the slope and scattered his ashes on the summit. It was on Round Mountain where in the eighteen seventies the orphaned printer boy, Robert Hill, first found fossil shells. His curiosity was aroused and from this place as a starting point he worked out the Comanche series now recognized wherever geology is taught. Dr. Hill died at Dallas, Texas, on July 28, 1941, aged eighty-two years.

## SCIENTIFIC EVENTS

### THE SCHOOL OF PUBLIC HEALTH OF THE UNIVERSITY OF MICHIGAN

THE Rockefeller Foundation and the W. K. Kellogg Foundation each contributed last January the sum of \$500,000 to be used in the establishment of a School of Public Health at the University of Michigan. As already announced in SCIENCE, Dr. Henry F. Vaughan has been appointed dean of the school. Dr. Vaughan is a son of the late Victor C. Vaughan, who was from 1891 until his death in 1929 dean of the Medical School of the university.

According to an account of the plans of the new school in *The Michigan Alumnus*, until this year, the M.P.H. degree has been granted for thirty hours of academic work. Forty-eight hours are required for

the degree now, with one year, at least, spent in the university and not less than twelve of the forty-eight hours given to field work. The practical experience is to be gained under the approval and direction of the School of Public Health, with at least six months to be devoted to it.

The program is set up so that after one year of study at Michigan the student enters the field of public health as a worker, either specializing in some branch with which he wishes to become particularly familiar or dividing his experience among several types of public health work for the purpose of gaining a general background. Not until after this practical experience is completed does the School of Public Health grant the degree.

Experience will be offered in areas outside the boundaries of the state, as well, in the South, East and West, the arrangement in the more distant areas to provide direction by expert workers in local public health units.

The advanced degree of doctor of public health will be granted to those who make contributions in special fields.

Drs. Thomas Francis, Jr., and Lowell T. Coggeshall, of the Rockefeller Foundation, New York, will be professor and chairman of the department of epidemiology and professor of epidemiology, respectively. Dr. John Sundwall, formerly professor and director of the Division of Hygiene and Public Health, has been named professor of hygiene and public health. Other transfers into the new unit include:

Nathan Sinai, professor of public health.

Dr. Emory W. Sink, assistant professor of public health.

Kenneth A. Easlick, assistant professor of public health dentistry.

Marguerite F. Hall, assistant professor of biometrics.

Lloyd R. Gates, instructor in public health engineering.

Dr. Lavinia G. MacKaye, instructor in child health.

Dr. David A. VanderSlic, instructor in school health.

#### THE ENGINEERS' COUNCIL FOR PROFESSIONAL DEVELOPMENT

FOUR hundred and sixty-one engineering curricula at one hundred and twenty-nine colleges and universities in the continental United States have now been accredited by the Engineers' Council for Professional Development, through the inspection program of its committee on engineering schools. Provisional accrediting has been given one hundred and four additional curricula. These figures were announced on October 30 at the ninth annual meeting of the Engineers' Council for Professional Development.

Committee reports on major activities of the council were made at the meeting, at which also officers were elected for 1941-42. R. E. Doherty, president of Carnegie Institute of Technology, Pittsburgh, Pa., was elected chairman for a second term; H. T. Woolson, executive engineer, Chrysler Corporation, was re-elected vice-chairman. H. H. Henline, national secretary of the American Institute of Electrical Engineers, was elected secretary of the council and A. B. Parsons, secretary of the American Institute of Mining and Metallurgical Engineers, New York, N. Y., assistant secretary.

Newly elected committee chairmen are: D. B. Prentice, president, Rose Polytechnic Institute, committee on engineering schools; E. S. Lee, engineer, general engineering laboratory, General Electric Company, committee on professional training; G. Ross Henninger, editor, American Institute of Electrical Engineers, committee on information. The following com-

mittee chairmen were re-elected for the coming year; R. L. Sackett, dean emeritus of engineering, Pennsylvania State College, committee on student selection and guidance; C. F. Scott, professor emeritus of electrical engineering, Yale University, committee on professional recognition; D. C. Jackson, professor emeritus of electrical engineering, Massachusetts Institute of Technology, committee on engineering ethics.

Nearly all the institutions in the United States which grant degrees in engineering have voluntarily submitted curricula for inspection by the committee on engineering schools since the beginning of the accrediting program in 1933. In 143 of 166 such institutions, 896 curricula have been inspected, including reinspection, since 1939, of 157 curricula. One or more curricula have been accredited in 129 schools. Accredited curricula number 461; provisionally accredited 104; action was deferred on 6; and accrediting has been refused to 167. Reinspections resulted in change of status for only 26 curricula. With the inspection program virtually complete, the committee is now engaged chiefly with reinspections of those curricula provisionally accredited.

#### THE EIGHTEENTH EXPOSITION OF CHEMICAL INDUSTRIES

THE eighteenth Exposition of Chemical Industries will be held at the Grand Central Palace, New York, from December 1 to 6. Dr. M. C. Whitaker, of the American Cyanamid Company, is chairman of the advisory committee. Among other members of the committee are: Dr. Raymond F. Bacon; Dr. L. H. Baekeland; Dr. W. S. Landis, president of the Chemists' Club; Dr. Raymond R. Ridgway, president of the Electrochemical Society, and Dr. E. R. Weidlein, director of the Mellon Institute.

The exhibits will demonstrate the rapid advance of chemical technology, raw materials, machinery and products in the following categories: chemical products, processing materials, manufacturing ingredients, manufacturing equipment, machinery and supplies, process control, technology, containers and plant construction.

According to the official announcement, significant facts which many of the exhibits will reflect bear out the following points:

Partly chemical industries are becoming more chemical. Nonchemical industries are consuming more chemical products and adopting chemical methods. Artificial materials are rapidly replacing natural products.

Synthetics, so much in the foreground just now, are no longer regarded merely as substitutes, but as new competitive materials. Many of them are created for specific purposes and serve those purposes better than the conventional materials they replace.

From laboratories and pilot plants not merely new

products but whole new industries are coming forth. One of the characteristics of the times is the evolution and marketing of new processes and equipment in the form of complete operative units.

Three hundred exhibitors have contracted for space on three floors of the Grand Central Palace amounting to more than three acres.

The exposition is permanently organized and presented biennially as an educational institution and clearing-house of information for chemical products, chemical process and chemically controlled industries. Its purpose is to bring together at one time and place the latest products of scientific research and the inventive application of all that is new and progressive in commercial practice; thereby creating a forum for the encouragement of science and the advancement of industry.

There have been arranged conferences and consultations between leaders in science and industry, personal contacts, discussions and demonstrations of new problems to be solved and new solutions of old problems.

Admission will be by invitation and registration at the Grand Central Palace. The exposition will not be open to the public at any time. It is under the management of International Exposition Company, manager of the biennial National Exposition of Power and Mechanical Engineering, and International Heating and Ventilating Exposition, and others. Charles F. Roth is manager; E. K. Stevens associate manager.

### A BRITISH SOCIETY OF NUTRITION

*The Lancet* states that an informal group composed of about twenty representatives of the main British laboratories working on nutrition started last year to meet about once a month. But it soon became apparent that even in war-time it was desirable to have meetings that were more formal and had a much larger attendance. Representatives of the institutes interested therefore met at the Royal Institution and decided to form the Nutrition Society, with the following provisional committee: Sir John Orr, Rowett Research Institute, *chairman*; John Hammond, School of Agriculture, Cambridge, *vice-chairman*; Leslie Harris, Nutritional Laboratory, Cambridge, *honorary secretary*; A. L. Bacharach, Glaxo Ltd., *honorary treasurer*; Harriette Chick, Lister Institute; Ethel M. Cruickshank, School of Agriculture, Cambridge; H. H. Green, Veterinary Laboratory, Weybridge; Professor H. P. Himsforth, University College Hospital; Professor A. St. G. Huggett, St. Mary's Hospital; Franklin Kidd, Food Investigation Board; S. K. Kon, National Institute for Research in Dairying; B. S. Platt, Medical Research Council; H. M. Sinclair, de-

partment of biochemistry, Oxford. About 230 investigators who are or have been working on nutrition have been invited to become original members; this number includes about 50 medical men and women. During the war the society will hold meetings for the discussion of specific topics at various research institutes. The first meeting was held at Cambridge on October 18, when the subject under discussion was "The Evaluation of Nutritional Status." An introductory address was made by Sir Gowland Hopkins. This was followed by Drs. Harris, Sinclair, John Yudkin and G. W. Robertson on "Assessment of the Level of Nutrition in Man"; Dr. Platt, Dr. R. H. Dobbs and W. C. W. Nixon on "Clinical Signs of Dietary Deficiency"; Drs. C. Crowther, Green and Hammond on "Nutrition of Farm Animals." These papers were followed by an open discussion.

*The Lancet* points out that it has been difficult in the past for the clinician to keep in touch with the advances made by the biochemist, and the agriculturist planning production has rarely been in direct contact with the dietitian who knows the community's needs. This new society will bring them together in the same room.

### THE HAVANA CONFERENCE OF NATIONAL COMMITTEES ON INTELLECTUAL COOPERATION

DR. STEPHEN DUGGAN, director of the Institute of International Education, who has leave of absence for six months, has accepted the invitation of Dr. Antonio S. de Bustamante, president of the Cuban National Commission of Intellectual Cooperation, to represent the institute at the Second Conference of National Committees on Intellectual Cooperation to be held in Havana on November 15. The general purpose of the conference is to examine the basic principles on which depend the existence of intellectual cooperation and the means of assuring the survival of different cultures in an atmosphere of tolerance and liberty. Consideration will be given to such questions as the protection of intellectual property (copyright); elimination of obstacles to inter-American intellectual cooperation (high tariffs on books, customs formalities, costs of voyages); increase of cultural relationships through the cinema, radio, theater, music, art; publications and interchange of professors and students; the coordination of relations between the national committees on intellectual cooperation, and the implementation of resolutions of inter-American conferences. Dr. Duggan will present a memorandum on "The Exchange of Professors and Students."

The official delegates to the conference in Havana will represent (1) official National Committees, (2) governments of the countries that have no official

National Committees and (3) unofficial National Committees that are affiliated with the International Institute of Intellectual Cooperation in Paris. The United States delegates will be in the third category, representing the National Committee of the United States of America on International Intellectual Cooperation, which has been actively associated with the Institute of Intellectual Cooperation of the League of Nations since 1926. Since the invitations to the conference came from the Cuban National Committee and not from the Cuban government, the United States government will not be officially represented, but Dr. Charles A. Thomson, chief of the Division of Cultural Relations of the State Department, will attend as an unofficial observer.

### AWARD OF THE PENROSE MEDAL OF THE GEOLOGICAL SOCIETY OF AMERICA

PROFESSOR NORMAN LEVI BOWEN, of the University of Chicago, has been awarded the Penrose Medal by the Council of the Geological Society of America "in recognition of his achievements in the application of the principles of physical chemistry to the study of the origin of igneous rocks." The presentation will be made at the annual meeting of the society at Boston on December 30.

The late Dr. R. A. F. Penrose, Jr., established the medal named in his honor in 1927 so that the Geological Society might signalize "eminent research in pure geology and outstanding original contributions or achievements which mark a decided advance in the science of geology." The distinguished company of geologists who have preceded Professor Bowen in receiving this honor include Thomas Chrowder Chamberlin, of the University of Chicago; Jakob Johannes Sederholm, director of the Geological Survey of Finland; François Alfred Antoine Lacroix, of Paris, France; William Morris Davis, of Harvard University; Edward Oscar Ulrich, of the U. S. Geological

Survey; Waldemar Lindgren, of the Massachusetts Institute of Technology; Charles Schuchert, of Yale University; Reginald Aldworth Daly, of Harvard University; Arthur Philemon Coleman, of the University of Toronto; Andrew Cowper Lawson, of the University of California; William Berryman Scott, of Princeton University, and Nelson Horatio Darton, of the U. S. Geological Survey.

The official announcement reads:

Professor Bowen, since 1937 Charles L. Hutchinson distinguished service professor of petrology at the University of Chicago, is a truly international figure in the field of petrologic research. A Canadian by birth, he took his baccalaureate degree at Queen's University, Kingston, Ontario, in 1907 and 1909. He was recalled to serve as professor of mineralogy, 1918-1920, and again in 1941 to receive an honorary degree at the centenary celebration of the university. He served as field geologist with the Ontario Department of Mines and the Geological Survey of Canada during the summers of 1907-1912. Advanced study at Massachusetts Institute of Technology brought the degree of doctor of philosophy in 1912, following which he became a member of the scientific staff of the Geophysical Laboratory of the Carnegie Institution of Washington. Here he remained, with the exception noted, until 1937 and here, with the inspiring leadership and cooperation of colleagues, he carried out his successful researches upon artificial melts simulating molten rocks which have won him high distinction including the Bigsby Medal of the Geological Society of London, and honorary membership in scientific societies of Russia, Belgium, Germany and India.

A long list of books and scientific papers published in American and European journals, testifying to productive scholarship, include contributions of significant value to the ceramic and glass-making industries. He is a co-discoverer of mullite, one of the fundamental constituents of fire clay refractories. During the world war the War Industries Board of the United States requisitioned his services in the control of production of optical glass strategically important in the successful prosecution of the war.

## SCIENTIFIC NOTES AND NEWS

A DINNER in honor of Dr. Harlow Shapley to mark the twentieth anniversary of his directorship of the Harvard College Observatory was given on November 7. More than a hundred astronomers and members of the faculty of Harvard University were present. The speakers were President Conant and Dr. A. Lawrence Lowell, president emeritus; Professor James R. Jewett, emeritus professor of Arabic; George Russell Agassiz, of the Museum of Comparative Zoology; Dr. Richard Prager, formerly of the observatory at Berlin-Babelsberg, and Professor Henry Norris Russell, of Princeton University, under whose direction Dr.

Shapley worked for his doctorate. Speakers from the observatory staff were Dr. Cecilia Payne-Gaposchkin, Miss Henrietta H. Swope, Professor Bart J. Bok and Leland Cunningham.

DR. ELMER K. BOLTON, chemical director of E. I. du Pont de Nemours and Company, who was associated with the research leading to the development of nylon and synthetic rubber, received the Chemical Industry Medal for 1941 at a joint meeting on November 7 of the American Section of the Society of Chemical Industry, the New York Section of the American

Chemical Society and the New York Section of the American Institute of Chemical Engineers. Dr. Lincoln T. Work, chairman of the American section of the society, presided at the meeting. Dr. C. M. A. Stine, vice-president of the du Pont Company, spoke on the personal side of the life of the medallist, and Professor Roger Adams, of the University of Illinois, spoke on his technical achievements. The medal, which may be awarded annually for a valuable application of chemical research to industry, was presented by Dr. Wallace P. Cohoe.

DR. MARTIN H. ITTNER, since 1896 chief chemist of Colgate and Company and the Colgate-Palmolive-Peet Company, has been awarded the Perkin Medal of the Society of Chemical Industry for 1942. The award is in recognition of his work in the development of a commercial process for the hydrogenation of fatty oils. The presentation will be made on January 9 at the Chemists' Club, New York City.

THE Vermilye Medal, awarded biennially by the Franklin Institute, Philadelphia, for service in the field of industrial management, has been awarded this year to William S. Knudsen, director general of the Office of Production Management, previously president of the General Motors Corporation. The award to Mr. Knudsen is made "in recognition of long years of outstanding managerial ability in American industry, characterized by brilliant initiative, far-seeing vision and human understanding, culminating in invaluable service to his country in the administration of unprecedented production for national defense." Presentation of the award will be made on December 1 at a dinner to be given in his honor at the Franklin Institute.

THE Bigelow Medal of the Boston Surgical Society was presented on November 7 to Dr. Allen O. Whipple, Valentine Mott professor of surgery at the College of Physicians and Surgeons of Columbia University.

DR. WILLIAM LYON PHELPS, professor emeritus of Yale University and now director of the Hall of Fame of New York University, received the Gold Medal of the Holland Society of New York at the annual dinner of the society on November 13 at the Plaza Hotel.

DR. ALEXANDER RUTHVEN, president of the University of Michigan, formerly curator and director of the Museum of Zoology and director of the University Museum, was elected on November 8 at the Chicago meeting president of the National Association of State Universities.

ARTHUR F. VAN DYCK, manager of the industry service section of the RCA Laboratories, has been elected president of the Institute of Radio Engineers.

THE California Museums Conference, at its meeting in San Francisco on October 11, changed its name to the Western Museums Conference. Dr. Robert C. Miller, director of the Museum of the California Academy of Sciences and of the Steinhart Aquarium, was elected president for the current year; Dr. E. Raymond Hall, curator of mammals at the Museum of Vertebrate Zoology of the University of California, was elected vice-president, and Arthur S. Coggeshall, director of the Santa Barbara Museum of Natural History, was elected secretary-treasurer.

T. D. KRONER, assistant professor of bacteriology of the department of bacteriology and pathology of Colorado State College, has been appointed assistant professor of bacteriology at the Louisiana State University. He takes the place of Dr. C. S. McCleskey, who has been called to active service in the Army.

DR. NICHOLAS E. WAGMAN has been appointed acting director of the Allegheny Observatory of the University of Pittsburgh. Dr. Edwin G. Ebbighausen and Miss Esther M. Doody have been appointed astronomers.

GRAYSON E. MEADE, a member of the staff of the Bureau of Economic Geology of the University of Texas, has been appointed instructor and research assistant in vertebrate paleontology at the Texas Technological College at Lubbock, Texas. He is a member of the staff both of the department of geology and petroleum engineering of the college and of the West Texas Museum, devoting half his time to each organization.

DR. LEONARD GREGORY PARSONS, professor of infant hygiene and the diseases of children, in the faculty of medicine at the University of Birmingham, England, who has been acting as deputy dean, has been made dean. He succeeds Dr. A. Stanley Barnes, who has resigned after serving for ten years.

DR. B. GOTTLIEB, formerly of Vienna, who spent last year at the School of Dentistry of the University of Michigan, has become associated with the Dental School of Baylor University.

DR. RAYMOND C. PARKER, formerly of the Rockefeller Institute for Medical Research, in New York City, and more recently with the Biological Laboratories of E. R. Squibb and Sons, in New Brunswick, N. J., has joined the research staff of the Connaught Laboratories of the University of Toronto.

DR. ROBERT A. MILLIKAN, chairman of the executive council of the California Institute of Technology, on November 12 presided over an Army luncheon at Los Angeles, which was sponsored by state and county military committees. Luncheon was served to five hundred civilians.

PROFESSOR RICHARD WELLINGTON, head of the division of pomology, and Dr. H. B. Tukey, chief in research in pomology, at the New York State Agricultural Experiment Station, Geneva, have been granted six months' leave of absence for travel and study. Dr. Robert S. Breed, head of the division of bacteriology, also has six months' leave to conduct a field survey for the Inter-American Committee for the Dairy Industries. Countries to be visited include Cuba, Costa Rica, Panama, Guatemala, El Salvador, Peru, Ecuador and Bolivia. A study of the research and educational facilities relative to the dairy industry will be made, together with a survey of public health activities pertaining to the control of milk supplies and other dairy products.

AN expedition to Central America from the University of California under the direction of Ruben A. Stirton, curator of mammals at the museum of paleontology, left Berkeley on November 6. It is planned to complete the collection and study of vertebrate life of El Salvador and to search for information that would establish a more correct date for the rise of the Isthmus of Panama from the sea. Mr. Stirton will be accompanied by six assistants, five of whom are teachers and graduate students in zoology, botany and paleontology in the university. They expect to stay in El Salvador for six months, during the dry season. Funds from private sources are financing the work.

THE third Barnard Hospital lecture will be given on November 18 at 8:30 P.M. in the auditorium of the St. Louis Medical Society by Dr. James B. Murphy, of the Rockefeller Institute for Medical Research. The lecture is entitled "An Analysis of the Trends in Cancer Research."

DR. BART J. BOK, of the Harvard College Observatory, will speak at a public meeting at the Franklin Institute of the Philadelphia Branch of the American Association of Scientific Workers on November 21 at 8:15 P.M. on "Pan-American Scientific Relations."

THE Committee on Scientific Research of the American Medical Association has made the following grants: Robert M. Virtue, University of Denver, formation of cholic acid; George Gomori, University of Chicago, study of enzymes in tissue sections; Fredrick M. Allen, New York Medical College, reduced temperature in surgery; Robert S. Dow, University of Oregon Medical School, effects of clotting in cerebral veins; Mary Juhn, University of Maryland, applicability of feather germ reaction to tumor diagnosis; H. M. Weaver, Wayne University College of Medicine, pain on distention of the stomach; Paul Thomas Young, University of Illinois, appetites and food preferences in the rat.

THE Medical Research Council of Ireland made the following awards during the half-year ended June 30, 1941: *Training grants*, Miss D. A. Kilbride, to carry out an investigation of iodine absorption by means of balance experiments, and Miss E. O'Donovan, to assist in the investigation of the goitre problem by studying the retention of iodine under varying conditions of diet. The work in both instances will be done in the department of chemistry of University College, Cork, under the direction of Professor J. Reilly and Dr. E. M. Mason.

THE U. S. Public Health Service is planning to appoint health education consultants in various defense areas. The positions, paying \$2,600 to \$3,800 a year, will be filled through open competitive examinations by the Civil Service Commission. A written test will not be given, but applicants will be rated on their qualifications as shown in their applications and corroborative evidence. Appointees will work with local health officers and their staffs, advising them as to methods and procedures of health education, such as individual instruction through interviews, group instruction through discussions, talks, lectures and other educational techniques. Applicants must have completed a 4-year college course, including or supplemented by special study—or for the assistant grade, experience—in public health. In addition they must have had experience in public health education work. Further information can be obtained from the Civil Service Commission in Washington, D. C. Applications should be received not later than December 11.

THE Virginia Academy of Science presented a panel discussion on "The Value of Scientific Research to Virginia Industry," on October 17, before the twentieth annual meeting of the Virginia Manufacturers Association in Roanoke, Va. Participating in the discussion were Dr. W. C. Calcott, director of the Jackson Memorial Laboratory, E. I. du Pont de Nemours and Company; Dr. Harrison E. Howe, editor of *Industrial and Engineering Chemistry*; Dr. Arthur Bevan, state geologist of Virginia, and D. J. Cederstrom, of the U. S. Geological Survey. Mr. Cederstrom took the place of H. K. McConnell, vice-president of the Tobacco By-Products and Chemical Corporation.

A MEETING on "Science in Defense Production" was held on November 12 at the School of Mines of Columbia University, under the sponsorship of the New York Branch of the American Association of Scientific Workers. Dr. Robert W. King, assistant to the president of the Bell Telephone Laboratories, reviewed the organization of scientific men in national defense and emphasized the general aspects of the application of scientific knowledge to defense production. Follow-

ing Dr. King, Jules Korchien, national education director of the Federation of Architects, Engineers, Chemists and Technicians, discussed the mobilization of scientific personnel.

THE first Pan American Congress of Mining Engineering and Geology will be held in Santiago, Chile, during the first two weeks of January.

DR. GILBERT MURRAY, regius professor of Greek at the University of Oxford, president of the British Committee of Intellectual Cooperation, has addressed a letter to the *London Times* under date of October 1, which reads: "On reading the magnificent appeal issued to the more thoughtful part of mankind by member after member of the conference of the British Association, I wonder if I may be allowed to express the thanks of many great men, now unable to speak

for themselves, who during the last twenty years have worked with me, and half the time under my chairmanship, for the acceptance of exactly the same message. Professor Einstein was able to send a communication; Sir F. Kenyon and Señor Madariaga are with us; but Bergson, Lorenz, Destree and the beloved Mme. Curie are dead, Bialobrzanski murdered, Herriot gagged, Huyzinga imprisoned; the names of others in Norway, Switzerland and other European countries it is safer not to speak. But I believe all would feel moved as I do on hearing at last the unmistakable voice of Great Britain uttering clearly that profession of faith for which we worked and appealed so long. My first impulse was almost to cry *Nunc Dimittis*; my second is to thank the British Association and its collaborators for the noble word, and to pray that in due time the deeds will follow."

## DISCUSSION

### WAR HYSTERIA IN CANADA

EARLY in September, 1940, two men rented a room in the home of Dr. Samuel Levine, research associate in geophysics at the University of Toronto, who has worked at Princeton, Pennsylvania and Cincinnati Universities in the United States and at the University of Cambridge in Great Britain and who is an authority on the forces controlling the stability of colloidal solutions. The men obtained permission to use a table in Dr. Levine's dining room for typing. Two weeks later, the police staged a midnight raid on the house and arrested the two roomers as Communists, also seizing a few pamphlets they found in the dining room. One of the arrested men, named Ehrlich, testified that these pamphlets were his property and not that of Dr. Levine. Nevertheless, the police two days later arrested Dr. Levine in his laboratory at the university for "possession of documents intended or likely to cause disaffection to His Majesty."

Dr. Levine was tried before a police magistrate and without a jury. His roomers testified that Dr. Levine knew nothing of their affairs, nor of the pamphlets. In spite of this testimony, the judge on October 10, 1940, sentenced Dr. Levine to six months' imprisonment. An appeal, heard on December 11, 1940, and again without a jury, was denied. At the appeal Professor Samuel Beatty, dean of the Faculty of Arts and head of the department of mathematics, and Professor E. F. Burton, head of the department of physics at the university, testified on Dr. Levine's behalf.

When three months of the sentence had been served, a request was made for remission of the sentence, supported by four leading professors at the university, all of whom had been Dr. Levine's teachers. These were Professor A. T. DeLury, retired dean of

the Arts Faculty; Professor J. L. Synge, head of the department of applied mathematics, and Professors Beatty and Burton. President H. J. Cody, of the university, and A. W. Roebuck, Member of Parliament for the district, also supported the request, which nevertheless was denied. Dr. Levine was released from the Ontario Reformatory at Guelph on May 15, 1941. He was immediately taken into custody by mounted police and sent to an internment camp, without being permitted to communicate with his family.

A determined struggle to obtain the release of her husband was then undertaken by Mrs. Levine. Editorials and articles on behalf of Dr. Levine appeared in many Canadian papers and he received the sympathetic support of many individuals in academic and public life. The American Association of Scientific Workers began to investigate the case following a request for aid by Mrs. Levine, and entered into correspondence with the Dominion Minister of Justice. According to the latter, Dr. Levine was interned on the Minister's orders, by virtue of powers granted under the Defence of Canada Act, "to prevent him from acting in a manner prejudicial to the public safety."

In spite of all protests, nearly three months elapsed before there was held the first hearing on the internment, and another month before the character hearing, both hearings being held "in camera." Finally still another month later, Dr. Levine was unconditionally released. Additional support was received at these hearings from Professor H. Eyring, of Princeton University, and from Dr. Levine's former colleagues at Cambridge. The importance of Dr. Levine's scientific work was stressed as an added reason for his release.

Sir William Mulock, chancellor of the University of Toronto and former Chief Justice of Canada, presented at these hearings a brief summarizing his study of the original trial. He characterized the evidence as inadequate and criticized the conduct of the trial judge.

Therefore, it appears that Dr. Levine was sentenced to prison, and to have remained with his internment a prisoner for nearly a year, because the trial judge and the Minister of Justice committed acts leading to a miscarriage of justice. They were enabled to act thus because the Defense of Canada Act, adopted in war hysteria, is harsh and undemocratic. Great Britain, closer than is Canada to the war's dangers, has not found such laws necessary. For example, possession in Canada of Communist pamphlets which are freely printed in Britain is an offense, as is membership in the Communist Party. American scientists are well aware through reading *Nature* of the free and active discussions on Marxism, socialism and dialectical materialism which are engaging the interests of British scientists. It is ironical that Dr. Levine incurred the enmity of the Fascists interned in the camp so that he was in danger of physical harm, and was transferred to another camp by the authorities.

Dr. Levine's devotion to his work is exemplified by the fact that he continued as best as he could under at times brutal treatment his research work in geophysics and practically completed the mathematical treatment of a complex problem in the theory of electrical transients as applied to the exploration of sub-surface formations. He is now seeking reinstatement at the University of Toronto, but this reinstatement, which rests with the Board of Governors, is not yet assured in spite of support by eminent colleagues.

The injustice to which Dr. Levine has been subjected through a year of baseless imprisonment may be continued unless the pressure of scientific opinion is exerted in his behalf. The success of the previous efforts by scientists in obtaining Dr. Levine's release augurs well for success in obtaining his reinstatement. The continuation of Dr. Levine's scientific work is particularly important now, since his geophysical researches promise to contribute significantly to the success of the Canadian war efforts in the international fight against Fascism. The scientists of the United States, as citizens of a country which is also pledged to cooperation in this fight, have the right to expect that Dr. Levine's training and abilities will be fully utilized by Canada in the aid of our joint efforts.

HARRY GRUNDFEST

OFFICE OF THE NATIONAL SECRETARY  
OF THE AMERICAN ASSOCIATION  
OF SCIENTIFIC WORKERS

## DIMINUTION IN ABILITY OF THE LIVER TO INACTIVATE ESTRONE IN VITAMIN B COMPLEX DEFICIENCY

THE recent work of Rhoads and his associates<sup>1</sup> on the effect of vitamin B complex in preventing cancer of the liver caused by dimethylaminoazobenzene, indicates that this involves a detoxication mechanism in which the cozymase system is implicated. This led us to investigate the possibility that the vitamin B complex might be concerned in the inactivation of other substances in the liver.

G. R. Biskind and Mark<sup>2</sup> demonstrated that when a pellet of a crystalline estrogen or androgen is implanted in the spleen of a castrate rat, the specific effect of the steroid is not manifest. If the spleen is subsequently transplanted subcutaneously and its pedicle ligated, the specific estrogenic or androgenic effect becomes evident. This method appeared to be ideal for investigation of the effect of vitamin B complex deficiency on the ability of the liver to inactivate steroids.

A preliminary study with estrone indicates that deficiency of the vitamin B complex in rats markedly diminishes the inactivation of this steroid in the liver. Pellets of estrone weighing approximately 5 mg were implanted in the spleens of adult castrate female rats. After a period of about 3 weeks on a normal diet, during which the rats remained anestrus, they were placed on a vitamin B complex-free diet. Within 2 weeks irregular estrual changes began to take place; after about 3 weeks the animals remained in constant or nearly constant estrus. After 39 days on the vitamin B complex-free diet the rats were sacrificed for inspection of the spleens. In no case were adhesions present that might have permitted blood from the spleen to enter the systemic circulation.

Further studies, both *in vivo* and *in vitro*, on the effect of the B vitamins on the inactivation of estrogens and androgens in the liver are in progress and will be reported in detail later.

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GERSON R. BISKIND

MOUNT ZION HOSPITAL AND  
UNIVERSITY OF CALIFORNIA MEDICAL SCHOOL,  
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## PANTOTHEN

THE substance which was named pantothenic acid has now arrived at the status of an important vitamin. Since like other vitamins it is destined to be almost

<sup>1</sup> C. P. Rhoads, *Proc. Inst. Med. Chicago*, 13: 198, 1940.

<sup>2</sup> Gerson R. Biskind and Jerome Mark, *Bull. Johns Hopkins Hosp.*, 45: 212, 1939.

a household article, it seems desirable to have a shorter name for it.

The tendency to abbreviate a long word is almost irresistible. It has sometimes been convenient to use the initials p.a. to designate the substance, but these same initials are used by medical men to mean pernicious anemia, and by physiologists to designate pyruvic acid.

It is suggested that especially for popular and semi-popular use the term *pantothen* be used as a substitute or abbreviation for the longer name.

ROGER J. WILLIAMS

THE UNIVERSITY OF TEXAS

### WANTED—SEDIMENTARY GALENAS

As may be seen from the abstract of A. O. Nier's work (University of Minnesota) included in the mimeographed edition of the "Report of the Committee on the Measurement of Geologic Time" just issued, especially pages 58-59, there is some indication that the age even of a common ore mineral like galena can be obtained from the proportion of isotopes in it, that the primal lead is indicated by the  $Pb^{204}$  and that the younger lead has a little larger proportion of the other isotopes which may be produced by radioactive disintegration which must be going on during geologic time.<sup>1</sup>

It will be noticed, however, in the results given on Table 2 that the galenas of Joplin, Missouri, have a relatively high proportion of the isotopes which may be of radiogenic origin. Just how this comes to be is a matter which needs further investigation, and while there are other matters of more importance at present, it would be well to get material ready for an investigation later. Galenas from other sedimentary occurrences, not only those in the three Missouri districts but in the Mississippi, or other sedimentary formations where the occurrence and geology is well known, would be desirable. If some of these occurred in connection with barite the facts should be noted.

Rarely, however, galena also occurs in the center of balls and septaria of siderite, clay iron stone, sometimes known as nigger head, and it might be possible to get valuable results from even two grams of such material. We hope that any such material will be kept for further scientific research and the Committee

on Measurement of Geologic Time will be glad to know about it.

ALFRED C. LANE

CAMBRIDGE, MASS.

### COLLECTION AND FILING OF SCIENTIFIC DATA

IN SCIENCE, issue of September 19, 1941, page 278, Alfred H. Taylor of the Experimental Research Laboratories, Burroughs Wellcome and Co., U. S. A., Tuckahoe, N. Y., suggests the collection and filing of data on absorption spectra at some central depository in order to make them easily available for all research workers. He points out how widely scattered the literature on absorption spectra is and how inconvenient it sometimes proves to obtain the data wanted even if they have been known for a long time. To avoid waste of time and money he proposes what may be called a sort of clearing-house outlining at the same time a working scheme for such an institution.

It may be of interest that in another field of science, human genetics, where the difficulties encountered are very much like those mentioned by Taylor, such a clearing-house dealing with genetical data in man has been set up by the Bureau of Human Heredity, 115 Gower Street, London, W. C. I., some years ago and has met with ever-growing success. The working methods of this institution are exactly like those described by Taylor (with the only exception that there is no charge for information) and have proved so efficient that, on request of many research workers, the Bureau of Human Heredity has resolved to make use of its methods for some special tasks—e.g., a survey on constitutional factors in cancer.

For this latter part of its activities the Bureau of Human Heredity has kindly been given hospitality by the Genetics Laboratory, Ohio State University, so that the work is now carried on in close cooperation by both institutions. The collection of data, although of course somewhat hampered by the conditions of war in Europe, is growing rapidly, owing to the interest of scientists all over the world; services may be expected to be available for all those interested in this field by next summer.

FR. BLANK

BUREAU OF HUMAN HEREDITY,  
LONDON; GENETICS LABORATORY,  
THE OHIO STATE UNIVERSITY

## SCIENTIFIC BOOKS

### PAPERS OF WADE HAMPTON FROST

*Papers of Wade Hampton Frost, M.D.; A Contribution to Epidemiological Method.* Edited by KENNETH F. MAXCY. viii + 628 pp. Illustrated. New York: Commonwealth Fund. \$3.00. 1941.

<sup>1</sup> See also paper by Nier, Thompson and Murphey, *Physical Review*, July 15, 1941, Vol. 60, pp. 112-116.

RARE is the demand for republishing articles from professional and official periodicals and bulletins, and unusual the honoring of an author by assembling after his death the significant contributions he made in medical literature to contemporary fact, method and thought. We have in hand a volume, dignified and pleasing in form, edited by men of superior discern-

ment with the devotion of life-long friendship and enduring admiration for the author.

To Wade Hampton Frost, student, administrator and teacher of epidemiology, we owe the flowering of this relatively new discipline of preventive medicine in the United States. The twenty papers selected for the distinction of this volume from among the sixty items of his bibliography reveal the initiation of novel inquiries, the interpretation of significantly correlated facts and the inductive and deductive reasoning by which Frost made an impression upon the science and practice of epidemiology and its public application to preventive medicine in our time.

An introduction, five sections under which the twenty papers are assembled by topics or stages of thought and objective, a bibliography and an index are included in the 628 pages of this book.

Quite apart from and in addition to the satisfaction of having in convenient form these classical studies of particular epidemics, their causes and control, the observant reader will gain from the related sections a sense of the passing of a simple descriptive epidemiology by its development into an elaborate constructive science built upon many others, and valuable as an intellectual exercise, an educational discipline and an analytical procedure of ever-expanding usefulness in determining attitudes and policies of personal and public medicine.

Frost's admiration for the demographic studies of Hirsch ("Historical and Geographic Pathology"), for the accurate observations, precise statements, the confidence, courage and logical reasoning of Snow ("On Continuous Molecular Changes," and "On the Mode of Communication of Cholera"), for Budd ("Typhoid Fever") and Panum ("On Measles") and for the studies and reports of Chapin of Providence, set goals of a perfection of presentation and deduction which he alone among American epidemiologists can be said to have achieved.

In the twenty pages of introduction by the editor, Kenneth F. Maxcy, himself a notable discoverer of new facts in epidemiology and a worthy successor to Dr. Frost as teacher, we learn of those origins and ways of life, family influences and professional experiences which had their share in affecting the directions of interest, the loyalty to scientific method and the precise ordering of evidence and its description characteristic of this man, whose thoughts and counsel drew to him a generation of eager colleagues and devoted friends.

Like many another notable commissioned officer of the U. S. Public Health Service, Frost had a varied training in hospital and field, office and laboratory, moving as orders required from one danger point to another where public need or an opportunity for evi-

dence called him. To have shared in the first successful abatement of yellow fever in New Orleans in 1905 must have been an exhilarating experience. Coast Guard cruises off New England and to European, South Atlantic and West Indies ports, followed by assignment to the Hygienic Laboratory for several years, prepared Frost for his early studies on typhoid fever and the initiation of a life-long concern with, and constructive development of stream pollution studies in the Ohio River basin and elsewhere. Then came his studies of epidemics of poliomyelitis, of which his descriptions set a standard of thoroughness and honesty for all later authors and reports.

The pandemic of influenza of 1918 called for new methods, painstaking techniques and a broad imagination, which Frost supplied.

From 1919 until his death in 1938 Dr. Frost's life was as professor of epidemiology at the School of Hygiene and Public Health of the Johns Hopkins University, the first such department and position in this country, and in these twenty years his influence was felt wherever the mass phenomenon, the natural history of disease as it occurs among peoples related by one or more common factors, is studied, taught or practiced.

The three papers in Section One range widely from the self-evident, the obvious or almost routine to the most confusing and obscure problems of epidemic disease. It was almost a foregone conclusion that the typhoid fever and diarrheas of Williamson and the Tug River watershed in West Virginia were causally related to the pollution of water supplies by sewage. A simple situation, characteristic of the great majority of small towns and even of many of our large cities in 1910, offered an easy solution. There is an adequacy of evidence, sound reasoning, a reasonableness and comprehensiveness of conclusions and recommended measures for prevention that reveal the competence of this first report of the field epidemiologist.

In the paper on "Septic Sore Throat," in Baltimore, again a relatively common occurrence, though less often identified in 1912 than in later years, a model is given of the way to approach an acute or explosive episode of that type. The best of modern practice in controlling milk-borne streptococcus sore throats has not gone beyond the procedures advised by Frost almost thirty years ago, and every alert local health officer makes the same series of observations and uses the same reasoning now when faced with similar episodes.

In the third, a monographic paper on poliomyelitis, there are assembled the basic reports of epidemic expression of this disease in rural Iowa, 1910, in Cincinnati, Ohio, 1911, and near Buffalo, New York, in 1912. Frost as a clinical observer sets a pattern of

classification of the disease, practically useful, and generally followed to-day. No subsequent outbreaks have been recorded with more effective testimony as to direct contact transmission, as to factors of distribution and the significant items of selection of the disease. We see here that comprehensive mastery of all the evidence and the ability to keep in their relative importance each factor of probable or possible bearing on origin, spread or termination of an epidemic, so characteristic of all Frost's contributions. Taken together with Bulletin 91, which followed in 1918 and recorded the national experience with the wide-spread epidemic of 1916, this paper (*Hygienic Laboratory Bulletin No. 90*) remains the essence of our knowledge of the epidemiology of poliomyelitis.

Section Two includes three brief papers dealing with the systematic study of stream pollution and water purification. In the first are the basic criteria applicable to measuring and expressing the sanitary quality of water supplies. The second deals with the history of increasing pollution of surface water supplies of many of our growing cities and the effect of measures initiated by sanitary engineers to purify them. The third paper is Frost's contribution to a notable symposium reviewing a decade of field and laboratory investigations in the Ohio River valley, and fully justifying the persistent concentration of the attention of the U. S. Public Health Service upon problems of technical laboratory methods, of measuring the efficiency of filtration plants and of the natural process of purification of streams.

In Section Three we meet for the first time instances of that initiation, testing and trust of new methods and techniques in the study of the prevalence and characteristic distribution of several acute communicable diseases in their endemic expression for which Frost's later papers became notable.

The descriptive epidemiology of influenza and studies upon frequency of its attacks, case incidence and fatality and other data obtained by the canvassing method applied to characteristic samples of population, all exhibit the careful planning, thorough checking and verification and scrupulous honesty of analysis and interpretation which were inherent in any undertaking with which Frost was associated.

There follow three papers on the common cold, acute minor respiratory diseases and the reciprocal relations of these to influenza in epidemic and non-epidemic form. Each of these deals with the observation of selected groups of intelligent people over long periods (eighteen to thirty months) by reports at relatively short intervals, calling for new methods for handling a mass of quantitative material. In the fourth and fifth papers Frost deals with inspection, immunity, morbidity and carrier prevalence of diph-

theria on the basis of comparable information in two well-separated periods of years in Baltimore. He seems to have settled at least for our time the three major factors accountable for the striking reduction in morbidity from diphtheria and their relative importance mathematically expressed.

Section Four gives us Frost's description of epidemiology, for philosophical and educational uses, his renaissance of Chapin's remarkable studies and methods of discovering the truth about the secondary attack rate among family or household contacts, paying loyal tribute to the genius and clarity of mind and expression of that pioneer in the practical administrative use of systematic epidemiology.

In the third and fourth papers Frost communes as it were with his associates in public health, and shares with them some of the limitations he has found inherent in the process of accounting for performance of public health services, cautioning the health officer to make no claims without ample evidence and logical reasoning, demanding of the administrator the same critical evaluation of causes and effects as is expected of the laboratory experimenter, the clinician, the statistician. His discussion of authoritative standards and a suitable method of arriving at them by a professional body has made a permanent impression upon the representative committees of the American Public Health Association and can well be taken to heart by other organizations devoted to science and the public weal.

Finally in Section Five we have three papers of the highest order, from the point of view of technical epidemiology or for their worth as permanent contributions to knowledge with prophetic implications. "Risks of Persons in Familial Contact with Pulmonary Tuberculosis," "Age Selection of Mortality from Tuberculosis in Successive Decades" and "How Much Control of Tuberculosis?" are a triad of texts indispensable to any critical analyst of the whither and how of the prevention of this disease.

A thoughtful and illuminating addendum to the bibliography of Frost's own papers is a list of twelve unpublished theses on tuberculosis by his students, now distinguished in their own right by public performance, and eight published papers on tuberculosis and rheumatic fever by the same and other collaborators.

The index is adequate, convenient and suitably brief.

This sampling of the most notable and characteristic products of the labor and thought of Wade Hampton Frost is a testament to which his successors in an indispensable science will turn for inspiration and discipline. The fortunate few who were blessed with his companionship for however short an experi-

ence will read through the lines of exquisitely expressed thoughts, and among the tables and charts of tested data, and recall the warmth, the nobility of presence, the generosity of attention and interest for others, the gentleness of his searching wit, the per-

vading wisdom of the man whose authorship is warrant of his distinction.

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## SPECIAL ARTICLES

### STUDIES ON INHIBITION OF FERMENTATION BY YEAST MACERATION JUICE

FERMENTATION of glucose by yeast maceration juice is dependent on the quantity of inorganic phosphate present and the state of activity of the juice. This dependence was studied by the manometric method of Warburg. The time of induction, the maximum rate of fermentation and the quantity of  $\text{CO}_2$  formed served to characterize the course of the fermentation.

Addition of phosphate prolongs the time of induction and decreases the maximum rate of fermentation, and is generally followed by a diminution of  $\text{CO}_2$  formation. Addition of phosphate augments the quantity of  $\text{CO}_2$  formed only if the quantity of phosphate present is not sufficient to satisfy the equation of Harden. The inhibition by phosphate is different from that by fluoride, which does not prolong the induction period, although it may increase the inhibitory effect of phosphate. The inhibition by phosphate is independent of the quantity of substrate but increases with decreasing concentration of maceration juice.

A "pre-fermentation" reduces the inhibitory effect of phosphate. The inhibition is also reduced if the phosphate is added during the course of fermentation. The inhibition is least if the addition takes place during the period of maximum rate of fermentation.

The addition of acetaldehyde reduces the phosphate inhibition. A certain amount of acetaldehyde has an optimum effect. On the other hand, if fermentation is inhibited by phosphate, accumulation of acetaldehyde during the fermentation is greatly diminished.

Pyocyanine and cytochrome C + cytochromoxidase give a similar reduction of phosphate inhibition. In these cases a consumption of  $\text{O}_2$  takes place, which, however, is very small in comparison with the additional formation of  $\text{CO}_2$ . The  $\text{O}_2$ -consumption is not inhibited by phosphate; on the contrary it is somewhat increased in the presence of higher phosphate concentrations.

To localize the interference by phosphate, decarboxylation of pyruvic acid and the formation of phosphoglyceric acid were examined. These processes were not inhibited by high quantities of phos-

phate, but were rather promoted by them. Analyses for phosphoglyceric acid revealed that its formation during the fermentation is inhibited by phosphate in the same degree as is the fermentation. After addition of acetaldehyde, however, its formation sets in nearly immediately and is not depressed following addition of phosphate.

The phosphate inhibition evidently affects one or more of the slower links following the formation of phosphoglyceric acid, rendering them still slower. In this way it inhibits the formation of acetaldehyde necessary to oxidize glyceric aldehyde phosphoric acid. Both the fact that phosphate renders the oxidation of glyceric aldehyde phosphoric acid more complete and the greater deficiency of acetaldehyde in the presence of more phosphate seem to be responsible for the greater  $\text{O}_2$  consumption in the presence of pyocyanine or the cytochrome system.

The different degrees of inhibition obtained in the various periods of fermentation or after a "pre-fermentation," can be explained by varying formation and accumulation of acetaldehyde and by the different speeds of the inhibitable links.

The inactivation of the maceration juice, which depends on age, temperature and dilution, decreases fermentation in the same manner as the addition of phosphate. The rate of the inactivation is greater, the lower the concentration of the juice. It is not based upon a monomolecular reaction. During the first stages of inactivation (which may be rather prolonged at low temperatures or scarcely demonstrable in the neighborhood of  $40^\circ \text{C.}$ ) the activity remains constant. In later stages the inactivation is accompanied by turbidity formation. During the inactivation an augmentation of susceptibility to phosphate inhibition takes place, whereas the inhibition by fluoride or monoiodoacetic acid is not similarly augmented.

In the presence of phosphate the inactivation and the formation of turbidity are retarded. It may be supposed that the original phosphate content of the juice acts as a stabilizer against inactivation.

The addition of acetaldehyde reduces the effects of the inactivation as well as does a short "pre-fermentation." This indicates that the enzyme is able to reactivate itself to a certain degree by the fermentation process.

A detailed exposition of this investigation will be published in *Arkiv för kemi*, Stockholm.

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# ON THE PORPHYRIN NATURE OF THE FLUORESCENT "BLOOD CAKED" WHISKERS OF PANTOTHENIC ACID DEFICIENT RATS

WEANLING rats fed a diet deficient in pantothenic acid develop, in a period of four to six weeks, peculiar symptoms characterized by the accumulation of red material around the nose and on the whiskers. Because of the superficial resemblance of this red material to coagulated blood the condition has been described as "nose bleed"<sup>1</sup> or "blood caked" whiskers.<sup>2</sup> However, no thorough studies on the chemical nature of the deposited red material have come to our attention. We have investigated the nature of the red material from a chemical point of view and have endeavored to trace its origin in the pantothenic acid deficient rat.

The red deposits on the nose and whiskers of pantothenic acid deficient rats exhibited a bright red fluorescence in ultraviolet light. An ultraviolet lamp (G.E.B.H.) was used as a light source. Hemochromogen tests showed that only a minute quantity of the material is hemoglobin. A large proportion was found to be a coproporphyrin. The heavy red deposit around the mouth and on the whiskers of several pantothenic acid deficient rats was collected by washing with water slightly acidified with acetic acid. Zeile and Rau's<sup>3</sup> modification of H. Fischer's extraction method for porphyrins was followed. The completeness of the extraction was controlled with the aid of ultraviolet light. The red fluorescent material was completely driven into 0.54 per cent. HCl (coproporphyrin fraction) and showed after washing with chloroform the following spectrum in 25 per cent. HCl: I 551 m $\mu$  II 570 m $\mu$  III 594 m $\mu$ ; the spectrum of its copper salt in pyridine was: I 565 m $\mu$  II 528 m $\mu$ . These spectra were compared with those of a sample of synthetic coproporphyrin I<sup>4</sup> and its copper salt respectively and proved to be identical under the experimental conditions. The spectroscopic measurements were carried out with the aid of a Zeiss pocket spectroscope, equipped with a wave-length scale.

Since it has been shown that the Harderian glands

<sup>1</sup> F. S. Daft and W. H. Sebrell, *Pub. Health Rep., U. S. P. H. S.*, 54: 2247, 1939.

<sup>2</sup> K. Unna, *Jour. Nutrition*, 20: 565, 1940.

<sup>3</sup> K. Zeile and B. Rau, *Zeits. physiol. Chem.*, 250: 197, 1937.

<sup>4</sup> The authors wish to thank Mr. Curt O. Porter, Department of Physiological Chemistry, The Johns Hopkins School of Medicine, for his generosity in supplying one of them with a highly purified sample of synthetic coproporphyrin I.

in rats exhibit a red fluorescence, and contain and secrete porphyrin<sup>5,6</sup> it was assumed that the fluorescent material might pass to the nose and whiskers of the rats by way of the naso lacrimal duct. An attempt to test this hypothesis revealed a fluorescent naso-lacrimal duct in a pantothenic acid deficient animal. It therefore appeared likely that the source of the porphyrin deposit was the Harderian gland. The Harderian glands were removed from eleven weanling albino rats; to insure complete removal of fluorescent tissue the operation was performed under ultraviolet light. The animals were then placed in all-glass cages and fed a diet deficient in pantothenic acid. Seven unoperated controls subsisting on an identical diet all developed fluorescent porphyrin deposits on the nose within six weeks. The eleven operated animals developed the other known symptoms of pantothenic acid deficiency, but no fluorescent red-colored material appeared on the nose, whiskers or fur.

Three grams of the fresh Harderian glands (from 17 animals) were extracted for porphyrins. In agreement with Derrien and Turchini<sup>5</sup> the main fraction appeared to be protoporphyrin. However, a very small fraction could be extracted with 0.54 per cent. HCl, and this was identified spectroscopically as coproporphyrin. The spectrum in 25 per cent. HCl was: I 553 m $\mu$  II 595 m $\mu$ ; the spectrum of the copper salt in pyridine was I 565 m $\mu$  II 530 m $\mu$  under the conditions of our experiments.

We therefore conclude that the red deposit around the nose and on the whiskers of pantothenic acid deficient rats is not blood but coproporphyrin and that this is derived from the Harderian gland.

After this paper was submitted for publication it was noted that Chick, Macrae and Worden<sup>7</sup> had attempted to characterize the reddish exudate which accumulates on rats deprived of vitamin B<sub>2</sub> factors. Our own independent and more exhaustive investigations confirm their observation that the material is not blood, and that it contains large amounts of porphyrin. They state that the material contains protoporphyrin. The data submitted above identify the porphyrin washed from the whiskers and fur of our rats as coproporphyrin.

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<sup>5</sup> E. Derrien and J. Turchini, *Compt. re* 91: 637, 1924.

<sup>6</sup> A. L. Graffin, *Anat. Rec.*, 79: 25, 1914

<sup>7</sup> H. Chick, T. F. Macrae and A. N. Jour., 34: 580, 1940.

<sup>8</sup> Rockefeller fellow, on leave of absence of Maryland Medical School

<sup>9</sup> The expenses of this study were from the Research Fund of the Yale Medical School.

# THE POLAROGRAPHIC CURVE OF SERUM FROM RATS FED p-DIMETHYL-AMINOAZOBENZENE<sup>1</sup>

White and White<sup>2, 3</sup> have demonstrated that growth inhibition resulted in young rats when carcinogenic chemicals and certain other organic compounds were included in the diet, and they reported that this could be corrected by dietary supplements of l-cystine and dl-methionine. It was concluded that certain carcinogens, as well as non-carcinogens, could induce a specific deficiency of the sulfur containing amino acids probably by imposing on the organisms an increased requirement for organic sulfur in the form of cystine or methionine for detoxication mechanisms. Since Brdička<sup>4</sup> has shown that the production of the polarographic curve obtained with blood serum is quantitatively proportional to the concentration of the sulfur-containing amino acids, we used the polarograph to obtain information regarding the level of these substances in the blood of rats on diets containing p-dimethylaminoazobenzene (butter yellow). Rusch, Klatt, Dirksen and Meloche<sup>5</sup> have pointed out that cystine is highest in the albumin fraction of the blood and found that the height of the polarographic curve was directly proportional to the amount of serum albumin.

Twenty-four young albino rats weighing 60-70 gm were divided into two series of 12 each. Three different basic diets were used. Diet I was composed of dextrin 77, casein 6, butter 5, crisco 5, salts 4, brewers yeast 2 and cod liver oil 1. Diet II was the same except that dextrin was reduced to 67, the casein was raised to 16, and 0.02 per cent. butter yellow was added. Diet III was the same as diet I except that 0.067 per cent. cystine and 0.02 per cent. butter yellow were added. In series I, three rats were killed at the beginning of the experiment, the remainder put on diet I and kept for 21 days when 3 more were sacrificed. Butter yellow (0.02 per cent.) was added to diet I and after 9 days on this ration, 3 were killed and the remaining 3 placed on diet II for 7 days more after which time they were also sacrificed. Series II was performed in the same manner, except that the rats kept on diet I for 30 days before making any polarographic determinations was observed and the rats were decapitated and it was prepared by the method previously described.<sup>5</sup>

was supported by the Jonathan Bowman Research.

<sup>1</sup> White, *Jour. Biol. Chem.*, 131: 149,

*National Cancer Inst.*, 1: 337, 1940. 142: 617, 1938.

<sup>2</sup> V. W. Meloche and A. J. Dirksen, *and Med.*, 44: 362, 1940.

The average height of the polarographic curves of the rats on normal diets in series I was 19.7 mm, but decreased to 17.5 mm on diet I, was further lowered to 15.8 mm when butter yellow was added and increased to 17.8 after the level of casein was raised. In series II, the figures were 20 mm for the controls, 15.3 mm after 30 days on diet I, 13.3 mm after butter yellow was added and 14.8 mm when additional cystine was included in the diet. In Fig. 1 representative

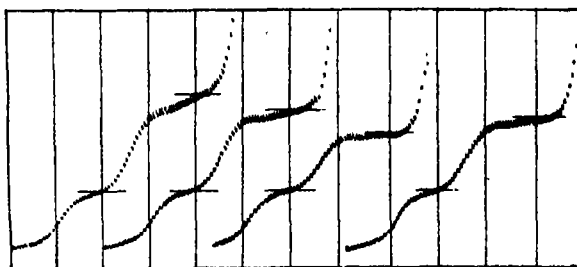


FIG. 1

curves of each group are arranged in the order just given. The lower curves found in series II were probably due to the greater depletion of cystine, since the rats were kept on the deficient diet over a longer period. The failure of the curves to return to the normal starting height may have been due to inadequate amounts of essential factors or to the short period allowed for recovery. From these results it is probable that the addition of butter yellow to the diet of rats resulted in a reduction in the level of the sulfur containing amino acids of the blood sera. This is in harmony with results obtained by different methods as reported by White and White.

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## VITAMIN B<sub>6</sub> AND GROWTH OF EXCISED TOMATO ROOTS IN AGAR CULTURE<sup>1</sup>

ROBBINS and Schmidt<sup>2</sup> reported that pyridoxine (vitamin B<sub>6</sub>) had a marked favorable effect on the growth of excised tomato roots in a mineral-sugar solution containing thiamin. Bonner and Devirian<sup>3</sup> obtained similar results. Bonner<sup>4</sup> reported beneficial results with five strains of tomato. Robbins<sup>5</sup> observed that the excised roots of one inbred tomato showed little response to pyridoxine while those of another

<sup>1</sup> Contributions from the Department of Botany, Smith College, New Series, No. 7.

<sup>2</sup> W. J. Robbins and M. B. Schmidt, *Am. Jour. Bot.*, 26: 149-159, 1939.

<sup>3</sup> J. Bonner and P. S. Devirian, *Am. Jour. Bot.*, 26: 661-665, 1939.

<sup>4</sup> J. Bonner, *Am. Jour. Bot.*, 27: 692-701, 1940.

<sup>5</sup> W. J. Robbins, *Science*, 92: 416, 1940.

inbred and the  $F_1$  heterotic hybrid exhibited considerable response. White<sup>6</sup> concluded that this vitamin did not improve the growth of excised tomato roots, while glycine had a marked beneficial effect.

In the experiments referred to above a liquid culture medium was used. The writer has determined the effect of pyridoxine on excised tomato roots in agar culture in experiments carried on at the New York Botanical Garden. The nutrient medium consisted of a modified Pfeffer's solution containing 1.0 per cent. sucrose and 0.5 per cent. purified agar to which thiamin, pyridoxine, nicotinamide, neopeptone, glutamic acid and glycine were added in various combinations.

The strain of excised tomato roots was that originally isolated by Robbins and Schmidt.<sup>7</sup> Fragments of roots which had grown for 47 or more successive passages in a mineral-sugar solution containing thiamin or a mineral-sugar solution containing the thiazole intermediate of thiamin were used as inoculum. The inoculum was therefore in all probability free of any material other than that synthesized by the roots or contained in the solutions given. Uniform pieces of the roots growing in these liquid cultures were transferred to the agar medium in Petri dishes. These were incubated in a moist chamber at 25° C. in the dark. In subsequent passages at eight- to ten-day intervals strongly growing and uniform appearing root tips 1.0 cm in length were transferred from the medium in one Petri dish to the same medium in another. Growth was determined at the end of each passage by measuring the increase in length of the main root. Growth of branch roots was not included in these measurements. In each

experiment from 12 to 31 root tips were grown on a particular medium.

In the basal medium the roots seldom grew for more than two passages. With the addition of thiamin similar root tips grew about 2.0 mm daily. In the same experiments, where pyridoxine was added to the agar medium containing thiamin, similar root tips generally showed a daily increment of 5.0–6.0 mm, or in several passages as much as 8.0 mm. Supplementing this medium with nicotinamide had no appreciable effect on the rate of growth. The further addition of neopeptone decreased the rate of growth to two thirds of that in the medium containing thiamin and pyridoxine. The addition of glutamic acid to the agar medium containing thiamin decreased the rate of growth. The addition of glycine to the agar medium containing thiamin had little or no effect.

Although the growth of the roots in the agar medium was less rapid than in the same medium without the agar, they appeared healthy and vigorous where suitable growth-substances were present. In one experiment the roots in the agar medium containing both thiamin and pyridoxine have grown for more than twenty passages during more than two hundred days with no diminution in rate of growth. The roots in the agar medium containing both thiamin and pyridoxine showed the characteristic hooks and curls noted by Robbins and Schmidt.<sup>2</sup>

Pyridoxine was of distinct benefit to the excised tomato roots in these experiments. Neither glutamic acid nor glycine in the amounts used appeared able to replace it.

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## SCIENTIFIC APPARATUS AND LABORATORY METHODS

### THE PREPARATION OF STERILE PROTEINS IN THE "LYOPHILED" STATE<sup>1</sup>

In the preparation of certain proteins (fibrinogen, thrombin) and proteinaceous material (chick embryo extract) in the lyophilized state, for uniform tissue culture media, it was noted that it was possible to obtain sterile preparations without the application of the elaborate and costly precautions necessary for aseptic technique. The sterility of these preparations was at first attributed to an empirical treatment of the dry protein with sodium-dried toluene for ten minutes at 60° C. The subsequent discovery that the method of removal of toluene after this treatment left traces of the toluene still in the material made it seem possible that it was the action of the compound over a period

of some days that was effective. This was confirmed by the observation that mass cultures of bacteria in the lyophilized state were killed by the application of dry toluene for a period of four weeks, but not by treatment with toluene for ten minutes at 60° C.

The role of the lyophile process itself in the sterilizing action was not at first suspected, since this is a common method of preserving bacterial cultures.<sup>2</sup>

The publication of Heller's<sup>3</sup> study of factors involved in survival and death of bacteria in the desiccated state made it clear that lyophilizing itself reduced considerably the number of organisms in a bacterial culture.

Because of the practical importance of being able to prepare, relatively easily, large quantities of sterile

<sup>1</sup> P. R. White, *Am. Jour. Bot.*, 27: 811–821, 1940.

<sup>2</sup> W. J. Robbins and M. B. Schmidt, *Bot. Gas.*, 99: 671–725, 1938.

<sup>3</sup> Aided by grants from the Rockefeller Foundation and from the Research Board of the University of California.

<sup>2</sup> H. F. Swift, *Jour. Exp. Med.*, 33: 89, 1921.

<sup>3</sup> George Heller, *Jour. Bact.*, 41: 109, 1941.

lyophilized protein for tissue culture studies, we made quantitative investigations of bacterial survival after certain combinations of chemical treatment and lyophilizing.

The test medium chosen was Brewers thioglycollate broth<sup>4</sup> because it supports the growth of anaerobes as well as aerobes.

A local contaminant (gram positive spore-former) was used as a test organism, since previously it had been shown to be more resistant to chemical and thermal treatment (toluene, ether, chloroform, acetone, propylene glycol, various degrees of heat) than any of four standard test organisms,<sup>5</sup> *Staph. aureus*, *Staph. albus*, *Ps. pyocyanea*, *B. subtilis*. The organism was always used as a 24-hour culture of a 24-hour culture.

The results of these experiments are summarized in Tables I and II.

TABLE 1

STERILIZING EFFECT OF CHEMICAL ADDED TO THE DRY RESIDUE AFTER LYOPHILING NUMBERS EQUAL VIABLE ORGANISMS/ML.

	Incubation 20 hours 37° C.	Lyophilized 24 hours	Lyophilized 24 hours plus Tol- uene	Relyo- philized
Experiment 1	2,900,000	100,000		
Experiment 2	2,800,000		130,000	30

TABLE 2

STERILIZING EFFECT OF CHEMICALS ADDED TO THE AQUEOUS MEDIUM BEFORE LYOPHILING

	Incubation 20 hours 37° C.	Lyophilized 24 hours
Inoculated medium ....	1,100,000	53,000
Inoculated medium plus toluene .....	Less than 2,000	0
Inoculated medium plus propylene glycol ....	Less than 2,000	0

These results indicate that reasonably clean handling of the proteinaceous material, plus toluene treatment and lyophilizing, will result in a sterile product.

The material from which proteins intended for subsequent sterile use are to be prepared should be handled in a clean way to reduce sources of contamination. Sufficient toluene should be added to saturate the original material, which then should be worked up in a cool room as quickly as possible to avoid multiplication of the contaminants present. If the product is not sterile, after lyophilizing, it may be dissolved in the amount of distilled water removed, toluene again added and relyophilized. In a planned experiment, using organisms in prime condition and using a selective medium, the organisms became non-culturable.

Preparations of fibrinogen, thrombin and plasma, all from slaughter-house beef blood, and of chick embryo

extract handled in the open air in non-sterile containers, have been obtained in the lyophilized state in sterile condition in this manner.

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## REMOVING FROZEN PLUNGERS OF GLASS SYRINGES

THE method of removing the plungers of frozen glass syringes suggested by McCoord<sup>1</sup> was formerly used in our laboratory exactly as he describes it. However, the difficulty in some cases due to the leakage of the water around the rubber gasket caused me to devise a somewhat surer method.

The same principle is used as that suggested by McCoord in which a small tuberculin syringe is utilized to give the necessary hydraulic pressure. Instead of connecting the two syringes by a hypodermic needle and rubber gasket, we have made use of a connector fashioned from the hubs of two broken hypodermic needles. These are brazed together so that they can be used to join the two syringes. In order to make certain that the hole in the needles has not been plugged up in the process of brazing they are subsequently drilled out with a small metal drill.<sup>2</sup> It is important that all air be removed from the system before exerting pressure. This can be accomplished in the "frozen" syringe by using a fine needle which will pass freely through the nipple.

This method has been used in our laboratory for the past five years and has never failed to release the plungers even though they are sealed by coagulated blood.

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<sup>1</sup> SCIENCE, Vol. 94, p. 170.

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<sup>4</sup> J. H. Brewer, *Jour. Bact.*, 30: 10, 1940.

<sup>5</sup> M. S. Marshall, J. B. Gunnison, M. P. Luxen, *Proc. Soc. Exp. Biol. Med.*, 43: 672, 1940.

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## SOCIAL IMPLICATIONS OF VITAMINS<sup>1</sup>

By Dr. ROBERT R. WILLIAMS

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THE theory of evolution has profoundly influenced the philosophical and religious thought of our generation as well as that of its predecessor. In alliance with the sciences of genetics and neurology it has shaped much of our thinking concerning the psychological and nervous organization of the human personality. At one time, especially under the influence of Herbert Spencer, the evolutionary concept had a profound influence upon theories of government and social organization. Perhaps it would not be going too far to say that the doctrine of *laissez-faire* had for a generation some of its main roots in the soil of

our views of the evolutionary process. In the present day of world-wide acceptance of planned economies and of various forms of paternalistic regimentation *laissez-faire* has become disreputable and scarcely any one is so poor as to do it reverence. Increasingly, popular thought classifies human social organization as a thing apart from nature, something to be dealt with as seems to us expedient.

Believing that it is a grave mistake to divorce any broad aspect of human life from its setting as a part of nature, I beg your indulgence to-day in departing from the shop talk of chemists, namely, chemical compounds and chemical reactions, and ask you to consider with me what man may learn from chemistry

<sup>1</sup> Lecture given on the occasion of the fiftieth anniversary celebration of the University of Chicago, September 22, 1941.

about how his own life may be reshaped with a maximum promise that it shall turn out nearer to his heart's desire.

The Darwinian theory of evolution drew its more certain data largely from morphology and particularly from the shapes of the skeletal remains of living creatures which have left their imprints in the rocks. This trustworthy morphological evidence was embellished and fortified with many rather speculative inferences from the conduct habits of creatures still living. This latter type of evidence has been increasingly discredited in our own times. The remaining morphological evidence presents relatively minor similarities amid major contrasts of the forms lying but a few inches or a few feet apart vertically in successive strata of the rocks. So long as the soundness of the idea of development of species by progressive changes was in dispute, the tendency was to emphasize how great changes may occur without complete eradication of tell-tale similarities. Alteration was exaggerated and the persistence of inherited traits was minimized so that, for the popular mind at least, the time scale was unduly foreshortened.

Consideration of the chemical descent of man, emphasized particularly by our new knowledge of the vitamins, corrects in great degree the illusory sense of gross, rapid and radical alteration suggested by morphology. It brings into prominence the underlying conservative principles in nature. Vitamin chemistry brings new and more intimate visions of the steps of evolutionary progress, for we find chemical evidences of community of inheritance in living things so far separated in the evolutionary scale that nearly all similarities of outward form have been erased. The far more pervasive and persistent chemical inheritances permit us to verify the successive inventions which have made an expanding life possible and to enrich the record with manifold new details.

Let us now review briefly the chemical evidence in support of the common inheritance of all living things. First, we should recall for the benefit of those less versed in chemistry that living matter is composed predominantly of compounds of carbon. Carbon, of all the elements, possesses the singular property of uniting with itself to form long chains which may be straight or forked or may double back upon themselves to form single or multiple rings. Occasionally an atom of nitrogen, oxygen or sulfur is enticed into a place in these chains or rings, but predominantly living matter is an interlacing linking of carbon to carbon with hydrogen atoms clinging at the sides of each carbon along the chains.

The significance of this peculiarity of carbon compounds may perhaps be rendered clearer by an analogy. The compounds of other elements which make

up inorganic nature may be compared to discrete word signs such as the Chinese use. There have to be as many signs as there are words to be expressed. By contrast carbon atoms resemble letters of an alphabet which may be linked together to form thousands of words from a few characters. The analogy is not perfect, for all carbon atoms are alike while the letters differ from one another, but the lack of diversity of carbon atoms is more than offset by the great variety, complexity and size of the spatial arrangements which they form, arrangements which we call molecules. There are approximately as many known compounds of carbon as there are words in the English language, and the structural formulas of even relatively simple ones often contain more characters than a German jaw-breaker.

It is a commonplace that the derivation of words in Caucasian tongues can be traced readily by the recurrence of familiar sequences of characters, often modified according to accepted rules. When one examines the significant carbon compounds which occur in living matter, one can not fail to be astounded by the recurrences of identical compounds throughout the entire evolutionary scale from unicellular microscopic yeasts to man himself. When one considers the scores, or hundreds, or even thousands of patterns into which those same carbon atoms might have arrayed themselves, any explanation of such recurrences of identical compounds, other than that of the common chemical inheritance of all living things, becomes virtually impossible.

In considering the complex carbon compounds which recur again and again in living nature, we shall pass over those which are common to animal forms alone. Among these are the hormones secreted by the endocrine glands. The use in human medicine of extracts from the glands of oxen or sheep is of course based on the fact that the active compounds are normal products of the physiological activity of man and beast. Thyroxine, for example, controls basal metabolism for frog, snake, bird and mammal.

We shall turn rather from these near relatives of ours and survey what is common to a much wider range of living things. We may mention first the role of glucose in nature. This substance is present to the extent of about five grams in the blood streams of each of us at this moment. Turn where you will, you will find it also in other blood streams and in the saps of plants, not as a trace substance but as an important intermediate of vital processes. The green plants make it from carbon dioxide and from it they produce starch and proteins. These plant carbohydrates and proteins are degraded by animals which consume them as food. In doing so, the animals retrace the downward steps again to glucose which is

in common burned as the source of vital activity, heat and mechanical work. Even the degradation of glucose to spent carbon dioxide and water we evidently learned from very distant progenitors for the process of glycolysis in our muscles follows for the most part a pathway common to that used by the humble yeast cell in the process of alcoholic fermentation. Many of the intermediate stages are identical.

If this were a single instance, it might be supposed fortuitous. Water is equally or even more universally and uniformly distributed in living things. As it is also abundant in inorganic nature, it is quite conceivable that the various forms of life just happened to incorporate water in their systems. Glucose differs in that it is not present in the inorganic world in perceptible amounts. However, the significance of the community of its role in living things rests on something far more profound than that. The metabolism of glucose follows a common pathway in diverse living things because it proceeds by the action of a whole series of complex organic catalysts known as enzymes. These enzyme molecules are too vast and complex for the chemist to decipher completely to-day, but we can now say that the prosthetic groups or business ends of these molecules are in many instances what we earlier came to call the vitamins. These vitamins are, therefore, the bits, the working ends, of the keys which unlock the stores of vital energy from glucose and other foods. The keys are master keys which perform the same function within the cells of all living things alike, to the best of our knowledge and belief. Since the keys turn smoothly in a thousand locks, can we suppose otherwise than that the keys and locks were fashioned by the same hand and mind when life first began to breathe?

There are many of these chemical mechanisms common to plants and animals. Vitamin C is a characteristic constituent of plants during growth but not during dormancy. Sprout a seed and vitamin C appears overnight. It is also present in the tissues and particularly in the livers of all animals so far examined. Man, the monkey and the guinea pig have to get it from the plants; other animals can make it for themselves. Vitamin E, occurring in wheat germ and lettuce leaf, is essential to the fertility of mammals. Oestrone, a mammalian female sex hormone, produces visible stimulation of the growth of young pea seedlings.

Still more conspicuous examples are found among the members of the vitamin B complex. Of these no other quite equals B<sub>1</sub>, the antiberiberi vitamin, in the profundity and universality of its essential action. It is present in every living tissue which has been critically examined. It is demonstrably required not only by every common mammalian species including

man but is also indispensable for flies, beetles, certain worms, bacteria, molds, fungi and yeasts. The higher plants fabricate hundreds of tons of it annually and store it in their seeds in quantity. Without it the sprouting seed can not form a root system. This may be demonstrated by sprouting tomato seeds in water and cutting off the rootlets when they have grown to a length of a half inch or so. The severed roots are then transferred to a solution of pure sugar and small amounts of nutrient salts. No further growth of the rootlets occurs unless vitamin B<sub>1</sub> is also added to the solution. If added in amounts ranging from one part in 40 million million to one part in 40 million, growth of the roots occurs in proportion to the amount added.

Vitamin B<sub>2</sub> or riboflavin also enters into several enzymes as part of the wide-spread oxidative mechanisms of living things. It occurs in most plant tissues and plays a role there like it plays in animals. Recently its importance in human nutrition has been emphasized by clinical observation of eye disturbances and lip sores which respond with amazing rapidity to small doses of the yellow pigment. A deficiency of it is now rated among the four or five most important deficiencies in the American diet, but the immediate causes of the shortage are not yet clear.

Nicotinic acid, a familiar substance, long known to chemists as a constituent of foods, turned out only four years ago to be the pellagra vitamin. Thousands of people died in the insane asylums of our South for lack of it and many thousands more still suffer some degree of impairment from a shortage of supply. Even before its efficacy for the treatment of pellagra was published evidence was forthcoming that staphylococcus, the common pus-forming organism, finds it equally indispensable for its humble life, as do also the roots of tomato plants. It is the prosthetic group of cozymase which floats in our blood stream and in the fluid contents of yeast cells, performing in each the same necessary function.

Another member of the B complex is pyridoxine, which was first found essential for the growth of rats and for the prevention of a dermatitis long confused with true pellagra. Its utility for several plants and microorganisms was tested at a venture with positive results. Tomato roots and certain molds, for example, require it as man does. It is coming into a limited use in human medicine.

The worth of most of the vitamins was first proved for animals, and it was not till many years had elapsed that attempts were made to prove that plant tissues which supply them actually fabricate them for their own needs. There are, however, three vitamins which were first recognized as growth substances for plants and were tried on animals only years later. These three are inositol, pantothenic acid and biotin.

They were known as useful for plants about fifteen, ten and five years respectively, before their animal functions were recognized. From these experiences, biochemists have come to feel that utility of a new natural substance in either kingdom justifies tentative presumption of utility in the other.

All these substances have been isolated in a pure state from nature and the structure of all of them except biotin has been determined and verified by synthesis. In general, their structures are highly specific and slight alterations of nature's pattern result in physiological inutility for the whole range of the evolutionary scale. Their structures vary greatly in complexity from one vitamin to another and there are no features which are common to them all. Each of them apparently represents an independent invention made by some of our common forebears and handed down impartially to all their heirs. The leaves of the ginkgo tree whose imprints, estimated to be twenty million years old, are found, true to the modern pattern, in the carboniferous rocks, as well as the leaves of the latest Burbanked fruit alike make the same vitamins and utilize them for the internal economies of the plants. The animals came much later than plants and can claim no share in the inventions but only in their adaptive application. More and more we who have long boasted ourselves as lords of creation find that we are also mendicants in nature's bread line and heirs of the grass of the fields.

So much for the water-soluble vitamins. The special function of the quite dissimilar fat soluble vitamins is less clear. They are not known to be components of enzyme systems, but they do definitely belong to both plant and animal kingdoms.

The existence of vision in animals is one of the outstanding marvels of nature. That the light reflected from a distant object can produce a faithful image in the consciousness of creatures at humble levels of the evolutionary scale seems to the reflective mind a miracle of adaptation. If all life were to be wiped out and the whole drama of evolution reenacted, would sight come again to the earth? If so, would nature employ new agencies or resort again to her lost art? That the latter might be the case is suggested by the fact that the photochemistry of vision appears to be similar wherever we encounter it.

The retinas of most vertebrates contain two groups of light receptors distinguished by their shapes as rods and cones. The rods function in dim light; the cones, in bright. Both rods and cones contain closely related photopigments which comprise a carotenoid in combination with a protein. Just as light affects the silver halide in your camera film and makes a picture from the varying darkness of the resulting silver particles, so light bleaches these pigments in each

microscopic rod and cone to make an image on the retina which is somehow transferred along the optic nerves to our brains and our consciousness. The photopigment of the rods is called rhodopsin or visual purple. It is a compound of a giant protein molecule with a molecule of vitamin A. By exposure to light, this compound is partly split into free protein and free vitamin A. The two cleavage products, however, are constantly recombining. In the dark, the recombining process overtakes the splitting process so the eye is fully rested to see again.

Before discussing further the function of vitamin A in the rods, let us refer briefly to the cones which contain a closely related violet pigment called iodopsin which also bleaches to a substance which is probably a simple derivative of vitamin A. Its chemistry is yet to be fully worked out. In chickens, color vision is achieved by three light filters, each consisting of colored oil globules. Wald has fractionated from the red globules a red hydrocarbon, astacene, the substance which gives the characteristic color to a boiled lobster, from the yellow globules the golden xanthophylls, lutein and zeaxanthin, which give also color to the yolks of chicken eggs, and from the third type of globules an unidentified greenish yellow carotene which appears to be identical with the coloring matter of the bacterium *Sarcina lutea*.

Let us now consider the molecular structure of carotene, the yellow coloring matter of carrots from which the name is derived. It comprises two six-carbon atom rings attached to either end of a straight chain of eighteen carbon atoms. From carotene the animal body can and regularly does derive vitamin A by splitting the chain in two in the middle and introducing the hydroxyl group, OH. There are many other carotenoids similar in structure to carotene or vitamin A but differing from them in the length of the chain, the position of the double bonds in the side chain and in the number of hydroxyl groups on it.

It is now clear that all vertebrates have constructed their visual systems by elaboration of a single theme. The isolation and identification of visual pigments is difficult chemistry and little has been done with the lower forms of life. Rhodopsin has recently been found in large quantities in the eye of a squid and such other fragmentary evidence as exists strongly suggests that some other invertebrates see by a closely kindred mechanism.

Perhaps we see beauty in verdant landscapes because our eyes mystically sense a kinship with the colors of the scene. If one prepares a water-free extract of the pigments of leaf or flower, protecting them the while from atmospheric oxidation, he can effect a beautiful separation of them into their prin-

cipal class components by simple means. It is only necessary to filter the extract slowly through a close-packed column of fine chalk, and color bands appear which become sharper as more fluid passes through. At the bottom are the yellow carotene bands which may be driven lower by pouring still more fresh solvent through the filter till the yellow colors collect in the flask at the bottom. From carotene, as we have already seen, all animal life is able to derive vitamin A. Without it there ensues blindness and general failure of the body mechanism.

Next, above the carotene band in our filter column are the reddish orange xanthophylls whose chemistry is unfortunately less well understood. They are, however, related to the hydrocarbon carotenes and differ from them principally by being dialcohols. (Vitamin A is a monoalcohol.) Among the xanthophylls which have been isolated is the red pigment of the tomato, lycopin and fuco-xanthin which colors the brown algae in our ponds. Another xanthophyll has already been mentioned as an essential component of the light filter of a chicken's eye and also as present in the yolk of its egg.

Above the xanthophylls in our filter column appear the green bands of the chlorophylls. Here is the spectrum of nature's color beauty: the yellow of the carotenes, the reds of the xanthophylls and the blue greens of the chlorophylls. Herewith she bedecks the flowers, fruits and foliage of her myriad higher plants and has some to spare for the wattles of the turkey and for the bodies of inconspicuous and forgotten primitive bacteria, mosses and fungi.

Something very like chlorophyll is in your blood—at least a huge portion of its molecular skeleton is there. Hemin is the prosthetic group or business end of the hemoglobin of mammalian blood. It contains four pyrrole rings joined in a giant circle with four intervening CH groups. At the center is an atom of iron which is "it" in this game of ring-around-the-rosy. The molecule of chlorophyll shows the same players in the same game except that now magnesium is "it." It is true that some of the little girls have different rib-

bons on their pigtails, but you could not mistake their identity.

Their common structural element is known as porphyrin. This vast carbon-nitrogen skeleton recurs again and again in the breathing systems of plant and animal life as an integral part of the substances which we have come to refer to as the respiratory pigments. When the hemin of blood is heated with soda lime, porphyrin is obtained identical in every detail with the porphyrin derived from chlorophyll. When you peel an apple with a steel knife and see the fresh cut surface darken presently in the air, you are witnessing the action of a porphyrin-containing oxidase. Put a drop of hydrogen peroxide on the surface and watch the oxygen evolve due to another porphyrin-base enzyme of the apple or of most any other vegetable tissue. It is called catalase.

Another well-nigh if not universal constituent of tissues is cytochrome, which may be recognized with a spectroscope by its absorption bands associated with its porphyrin nucleus. If yeast is kept from contact with the air the cytochrome bands appear strongly. They fade and return as oxygen is admitted and again excluded. Choke a wax moth and the absorption bands of cytochrome appear throughout its body tissues, the more quickly as its struggles exhaust its internal oxygen supply. Let it breathe freely again and the bands disappear. Cytochrome is one of a number of links in the chain whereby glucose is oxidized by living tissues. It serves to transfer oxygen from the air to the food molecule which is to be oxidized. We do not know that animals depend on plants in any way for their daily supplies of porphyrin base enzymes, but we can guess whence they inherited the skill to use them.

Surely we need not labor through further examples. The revelation provided by vitamin chemistry seems sufficient to convince the skeptic that while nature has *altered* much in proceeding from amoeba to Einstein or Dorothy Lamour, she has *preserved* even more through all the vicissitudes of evolutionary history.

(To be concluded in the issue of Science for November 28)

## THE USE AND MISUSE OF SCIENCE IN GOVERNMENT<sup>1</sup>

By Dr. A. V. HILL, M.P.

FOULERTON RESEARCH PROFESSOR AND SECRETARY OF THE ROYAL SOCIETY

In this country we do not believe in bureaucracy. Our national genius has evolved a system by which the activities of officials are continually subject to the advice and help and criticism of public-spirited citi-

<sup>1</sup> From an address given at the Conference on Science and World Order of the British Association for the Advancement of Science, organized by the Division for the Social and International Relations of Science.

zens. The wise officials appreciate this; the stupid ones do not. Let us never abandon this principle, otherwise, with our traditions, we are in for a long spell of trouble. Let us rather praise and extend it, whatever our totalitarian youth may say. One way to extend it is to insist that independent scientific advice shall be given a constitutional place, and a con-

stitutional right to be heard, in government departments.

Even, however, if departments were saturated with scientific advice, it would still be necessary to ensure that the Cabinet itself should be properly served. The Scientific Advisory Committee and the Engineering Advisory Committee, both under the chairmanship of Lord Hankey, now fulfil that function here. The arrangement is new, but undoubtedly it works well. Dealing as they do with the reactions of science and technology with policy, at present particularly but not exclusively in connection with the war, the committees can not busy themselves with details which naturally go to departmental bodies, and most of their activities can not in wartime be publicly described. The chairman, as a minister of high rank, working under the Lord President of the Council, who is the member of the War Cabinet primarily responsible for research, has access to all ministers and departments. A new link has thus been forged, and science at last is in contact with the center of government.

In the United States a similar link exists. The director of the Office of Scientific Research and Development in Washington is directly responsible to the President. Under this organization come the National Defense Research Committee, the National Advisory Committee for Aeronautics and the Medical Division of the National Research Council. This arrangement is quite new, and in many ways different from our own; but it is like it in the sense that in the United States, as here, science now has direct access to the center of government. May it so continue in both countries!

I have dealt with the attitude of mind from which the problems of science in government must be approached, and with the organization needed at departmental and Cabinet level. It remains now to deal with the scientists themselves and the problem of how to keep them alive. It is essential, if the scientific minds of the scientists in government employment are to be saved from sterility, and their souls perhaps from damnation, that there should be as little distinction as possible between them and those in the universities, in industry and in other independent institutions. In wartime there is little distinction; we are all in it together. What I say applies to the more normal times of peace.

Government scientific employment in general has certain characteristics:

- (1) It has security of tenure, fixed hours of work, regular promotion and a pension.
- (2) Adequate equipment is usually available, and there is not a continual struggle for funds.
- (3) The object and direction of investigation are usually laid down by authority.
- (4) Discussion and publication are usually limited,

sometimes because of the real or alleged necessity of secrecy, often simply by tradition.

(5) Teaching duties generally do not exist, and there is often no necessity to follow the scientific literature except in a special field, with the result that interests are likely to become narrow.

(6) Attendance at meetings of learned societies, conferences and congresses, the holding of colloquia and discussion meetings and contacts with scientists in other fields are rare.

(7) Visiting workers, particularly foreign workers, are few or absent altogether.

For such reasons, unless a man has exceptional ambition and originality, his initiative and keenness tend to be blunted. There are several ways to avoid this:

(a) To ensure that directors of research, heads of laboratories, etc., are people of exceptional quality, not only in ability, originality and experience, but also in their human relations and sympathy. Such men in such positions are rare, but they exist; their value is very great. It is essential that they should remain investigators at heart, and as far as possible in action, and not become mere bureaucrats.

(b) To adopt a common pension scheme, similar to that of the Federated Universities System, with the universities, with industrial laboratories and with all institutions in which scientific work is done.

(c) To encourage junior and senior workers alike to interchange freely with other departments, with industrial laboratories or with universities.

(d) To provide facilities for visiting workers, for colloquia and discussion meetings and for attendance at meetings of learned societies.

(e) To adopt a system analogous to that of the reserve of officers and other ranks by which the fighting services prepare for times of emergency. Many of the ablest workers elsewhere would rightly value a period of service in government laboratories, although not prepared to devote the whole of their lives to it. After their period of service, they would return to their chosen jobs in universities and other places, with occasional "refresher" periods later.

I have urged before that this system of building up a reserve of scientific officers should be adopted as soon as normal conditions return. It would be the greatest pity if the many able men who have done such excellent service in Government establishments should then lose touch permanently. Wide-spread support of this proposal has been evident. It has many advantages; sudden expansion in emergency would be much easier, the universities and other institutions would be kept in touch with government scientific establishments, and *vice versa*, those who joined the government service would not be permanently isolated from the scientific workers outside, and the highly interesting and important work which is done in government laboratories would be more commonly appre-

ciated and known. By forming such a reserve, the intellectual status and the fruitfulness of government science would inevitably be raised and the universities would be brought into closer touch with realities.

There is no need to go into details; they can be settled later. The broad principle is that in every way we need to break down barriers between universities, independent research institutions, industrial laboratories and the scientific establishments and service of the government. This can be done by regular interchange of personnel, by a common pension system, by providing in the government laboratories all those facilities for discussion, for meetings, for criticism, for initiative, for collaboration—even perhaps for teaching—which are found elsewhere. We must not be deterred in this project by bureaucratic objections, by false economy, by the red-herring of secrecy or by alleged administrative difficulties. In science also we must deliberately follow the line of our national genius and ensure the fullest cooperation and interchange between independent science and science controlled by the state.

This plan for a reserve of officers and for frequent and regular interchange between different kinds of institutions need not be limited to science; it should be open to the government service as a whole. Drastic changes are needed in the Civil Service. Personal ability and personal integrity, essential as they are, are not sufficient; the outlook, the methods, the organization, the traditions of the Civil Service must be altered, and contact must be maintained with the real world and its methods outside. The war has shown, what many suspected already, that for all its devotion and its high traditions, the Civil Service has largely failed; the same might well be said of Parliament, but that is another matter. Nothing could be better for the Civil Service, for industry, for the universities, than to institute a regular interchange of personnel;

to treat the universities as staff colleges to which workers from the Civil Service or from industry return at intervals for refreshment; to treat industry and the Civil Service as the workshops in which for a period university dons can obtain practical experience; to give to government offices a touch with reality, and to industry a touch with national needs, by the mutual temporary interchange of some of the ablest men on either side. We are concerned here to-day primarily with science in government. Science, however, will never be given full scope until a revolution has occurred in the methods and outlook of government itself.

May I finish on a note, not of criticism but of hope? Under the old régime of *laissez-faire*, which we intend that the proper use of science in government shall replace, our public health services were organized mainly on the principle of trying to cure people when they were sick, our architecture on mending the pipes when they burst after a frost, our industry on paying people a dole when they were unemployed, our national defense on getting ready when a war had begun. It is obvious, however, that scientific planning and the planning of our national resources can make many of our troubles unnecessary. By designing our houses properly the pipes need never get frozen up; by proper attention to nutrition, to public health and physical education, sickness can be largely avoided; by deliberate planning of public works, unemployment can be greatly reduced and the standard of living raised; by adopting a period of national service, universal for men and women alike, as the highest form of democracy, we can avoid blundering unprepared again into war, and can add a new dignity to our citizenship. Scientific planning and planning with the aid of science are what we look forward to; planning, however, in which any new order we arrive at is fitted to our traditional freedom.

## OBITUARY

### WILLIAM ALBERT NOYES, 1857-1941

WILLIAM ALBERT NOYES departed this life on October 24, 1941, at his home in Urbana, Illinois, aged 83 years, 11 months.

How familiar the form of such an announcement! It marks the beginning and ending of life, the two covers of the book, but of the contents—particularly rich in this case—not a word.

Dr. Noyes was born in the country near Independence, Iowa, November 6, 1857. His family, of New England Congregational stock, lived under pioneer conditions not favorable to the study of chemistry and physics; nevertheless, as a boy he managed to get hold of some scientific books and became interested in these

subjects at an early age. In the midst of farm work he prepared himself for college, almost without a teacher. In the Iowa college of that day little chemistry was taught, but this was supplemented by a large amount of self-instruction. At the end of four years the young man was W. A. Noyes, A.B. and B.S., in spite of the fact that he had taught school every winter to pay expenses. He conducted much of his graduate work himself while carrying a full load of teaching, so that he was able to take his doctor's degree in chemistry at Johns Hopkins under Remsen in a year and a half, before reaching the age of twenty-five.

Such unrelenting labor was characteristic of Dr. Noyes throughout his long life. During a year as

instructor at the University of Minnesota he performed much analytical work for the State Geological Survey (just as he later did in Indiana) and began original research of his own. The research was continued at the University of Tennessee, where he was professor from 1883 to 1886. A seventeen-year period followed at Rose Polytechnic Institute, a small school of high grade. This was just the sort of place where many a man, condemned to a heavy teaching load, with improvised equipment and with little or no graduate assistance, would have sunk out of sight; Dr. Noyes attracted the attention of the chemical world by his researches and his books.

From Rose he stepped in 1903 to the position of chief chemist of the Bureau of Standards (the first to hold that title), and from there to head of the department of chemistry of the University of Illinois, where he served with distinction from 1907 to 1926, becoming then professor emeritus. In recognition of his success in building during this period a great department, the university in 1939 dedicated the scene of his labors as the William Albert Noyes Laboratory of Chemistry. Dr. Noyes himself took part in the dedication, surrounded by many staff members whom he had selected. His pathway had been strewn with well-deserved honors: presidency of the Indiana Academy of Science (1894), vice-presidency of the American Association for the Advancement of Science (1896), presidency of the American Chemical Society (1920); degrees from Clark in 1909, Pittsburgh in 1920, and Grinnell (his alma mater) in 1929; memberships in the American Academy of Arts and Sciences, the National Academy of Sciences, the American Philosophical Society; the Nichols medal (1908), the Willard Gibbs medal (1920), the Priestley medal (1935).

Dr. Noyes was married three times. By the first union he leaves W. Albert Noyes, Junior, head of the chemistry department of the University of Rochester; by the second, Charles Edmund, engaged in newspaper and information work in Washington, D. C.; by the third, his widow Katharine Macy Noyes and their sons, Richard Macy, graduate student in chemistry at California Institute of Technology, and Henry Pierre, Harvard undergraduate.

It is difficult in so short a biography to give a true idea of Dr. Noyes' many-sided life work. Perhaps we should first characterize his research, the principal part of which was performed with his own hands. From the oxidation of benzene derivatives with potassium ferricyanide, which links him with his teacher Remsen, he turned to the exact determination of the hydrogen-oxygen ratio, which is at the basis of our system of atomic weights. So excellent was this piece of work that it stands to-day as one of the nearest approaches to the probable truth for this value. His

later determination of the atomic weight of chlorine was also outstanding. Methods for the determination of phosphorus, sulfur and manganese in iron constituted a fruitful excursion into the analytical field. During the course of a long series of important researches on camphor Dr. Noyes was the first to furnish definite proof of its present accepted structure (the Bredt formula). Other organic researches dealt with the hydrolysis of maltose and dextrin, molecular rearrangements, optically active diazo compounds and amine oxides. He was active as an investigator almost to the end of his life.

In 1901 a study of the formation of nitrogen trichloride from ammonia and chlorine led Dr. Noyes to the hypothesis that the molecules of elements may ionize into positive and negative parts and to the thought that two kinds of nitrogen trichloride might be capable of existence, one in which the nitrogen is positive and the chlorine negative, and one in which the opposite relations hold. He was thus one of the earliest investigators to recognize that the older conceptions of valence were inadequate to explain experimental facts. From that time on he took an active part in the development of the theory of valence and reactions.

At the turn of the century powerful influences began to operate under which the American Chemical Society, originally a local organization in New York, was destined to become the great national organization that it is to-day. Dr. Noyes was one of the leaders in this development. He saw that the greatest source of strength in such a society lay in disseminating the results of research. His friend Edward Hart had put the *Journal of the American Chemical Society* on its feet; Dr. Noyes took over the editorship in 1902 and held it for fifteen years. Together these men made the *Journal* respected the world over and drew to it the best contributions of American chemists. Besides original articles there had been since 1897 an abstracts section limited to American chemical research. This was not broad enough to satisfy Dr. Noyes. In 1907 he founded *Chemical Abstracts*, summoning to his aid a brilliant corps of nearly thirty assistant editors, and remained its editor for three years at considerable personal sacrifice. Thus he created a "key to the world's chemical literature," as the greatly expanded periodical now justly calls itself. Through the joint efforts of Noyes, Parsons and many others the society grew by leaps and bounds. Dr. Noyes found time to serve as secretary from 1903 to 1907 and as president in 1920. In the latter year he became editor of the series of American Chemical Society Scientific Monographs, a position which he held to his death; he was also the first editor of *Chemical Reviews*, from 1924 to 1926.

As if this varied editorial output were not enough,

several successful text-books bear the name of Noyes: "Elements of Qualitative Analysis," "Organic Chemistry for the Laboratory," "Organic Chemistry" (with a German translation), "Textbook of Chemistry," "Laboratory Exercises in Chemistry," "College Textbook of Chemistry." "Modern Alchemy," a book for lay readers, in collaboration with W. Albert Noyes, Jr., was published in 1932. One need not wonder that Dr. Noyes was often seen at meetings, on the train or at home, with a sheaf of printer's proofs in his hand.

The personal character of William Albert Noyes has been left to the last, but it is the key to all that has preceded. One would judge from his life that genius is fine intellect with capacity for a tremendous amount of hard work. He was first of all a scientific thinker, less affected by emotion or selfish bias than any man the writer has ever known, and utterly unassuming. He was a hard, persistent fighter for whatever he thought was right, and he was right most of the time. Unusual patience, earnestness and the force of example contributed to his success as a teacher. The fabric of Dr. Noyes's achievements was shot through with loyal friendships and strong humanitarian sympathies. Perhaps his deepest interest was religion—a liberal faith which he felt to be in harmony with scientific truth and at the same time a vital faith, something to be lived.

Dr. Noyes was a strong believer in promoting better international understandings as a means of preserving peace and curbing aggression. He felt that scientists, on account of their international community of interest, have a special duty in this field. During the troubled years which have followed the first World War, he made vigorous efforts to draw scientists of different nations closer together. He attended meetings in Europe on different occasions, and published two pamphlets entitled "Building for Peace," besides other articles. His belief never wavered that such efforts, by himself and others of like mind, will finally prevail. Certainly the life and work of William Albert Noyes, distinguished scientist who loved his fellow men, will be no small influence toward the better world of which he dreamed.

AUSTIN M. PATTERSON

U. S. OFFICE OF EDUCATION

### MATARO NAGAYO

ON August 16, 1941, Baron Professor Mataro Nagayo, president of the Japanese Foundation for Cancer Research, died of cancer.

He was born on April 6, 1878, in Tokyo, as the third son of Sensai Nagayo, who exerted a great influence on the propagation of Western system of medicine and hygiene in Japan. In 1904 he graduated from Tokyo Imperial University Medical College, and

the next year was appointed assistant in pathology in the university. In 1907 he was sent by the government to Europe, where he studied pathology mostly under Professor Aschoff at Freiburg. Returning to Japan in 1909, he was made assistant professor, and in 1911 was promoted to a full professorship in pathology, which he held until 1933. During 1919–1934 he was director of the Government Institute for Infectious Diseases and was most successful in organizing it into a powerful research center. In 1933 he was made dean of the Medical Faculty of Tokyo Imperial University, and in 1934 was elected president of the university. He retired from his duty at Tokyo Imperial University in 1938 with the title of professor emeritus.

Professor Nagayo early became closely connected with the Japanese Foundation for Cancer Research, then called Japanese Society of Cancer Research. In 1915 he became chairman of the executive committee, and in 1929 was unanimously elected president of the foundation. It must be freely acknowledged that the development of the work of the foundation has been almost entirely due to the earnest effort of President Nagayo, and that he is the founder of the Laboratories and Koraku Hospital of the Foundation. With the establishment of the laboratories in 1933 he assumed the directorship.

Professor Nagayo's personal contributions to science include some 200 published papers. His early studies on the pathology of liver cirrhosis and of beri-beri are widely quoted. During his directorship at the Government Institute for Infectious Diseases he attacked that baffling tsutsugamushi disease and finally established its etiology by discovering *Rickettsia orientalis*. His "Statistical Study of Cancer in Japan," published as a special number of *Gann*, is of permanent value. Studies he started on the brains of superior men in Japan produced morphological evidence that the brain of the Japanese is in no way inferior to that of the European.

The international aspect of Professor Nagayo's activity was wide and varied. In 1921 he went to Batavia, Java, as the Japanese representative to the Far Eastern Association of Tropical Medicine, of which association he was vice-president at the Tokyo Congress in 1925. In 1923 he was a member of the Japanese Medical Mission to the United States at the invitation of the Rockefeller Foundation. In 1928 he represented Japan at the Health Congress of the League of Nations (Geneva), the Congress for the Standardization of Serum (Copenhagen), the Leprosy Congress (Paris) and also the Cancer Congress (London). By request, he had served since 1933 as an advisory trustee to the International Cancer Research Foundation, Philadelphia, U. S. A. Professor Nagayo

spoke German and English well and made many friends in the countries he visited and won their trust and confidence. Eventually it became customary for all the distinguished medical men from foreign countries visiting Japan to visit Professor Nagayo, and they have gone away cherishing the kindest remembrance of his friendship and hospitality.

It is impossible to enumerate all the honors he received for his service to science and to his country. He was made a member of the Imperial Academy in 1936, and was elected an honorary member of the German Academy of Natural Science in Halle in 1939. When his condition was reported critical, H. I. M. the Emperor of Japan created him a peer with the title of Baron, and decorated him with the First Class Order of the Sacred Treasures.

A great leader has passed from us, but he has left a record of achievement that will be a source of inspiration to future generations, while to all who came in personal contact with him there remains a vivid memory of his truly distinguished personality.

WARO NAKAHARA

TOKYO, JAPAN

## DEATHS AND MEMORIALS

DR. PAUL STILWELL McKIBBEN, professor of anatomy and dean of the School of Medicine of the University of Southern California, died on November 12 in his fifty-sixth year.

DR. HUBERT VINTON CARPENTER, professor of mechanics and electrical engineering and dean of the College of Mechanical Arts and Engineering and di-

rector of the Engineering Experiment Station at Washington State College, died on November 15, at the age of sixty-six years.

DR. CARRIE M. DERICK, since 1929 emeritus professor of morphology, botany and genetics at McGill University, died on November 10 at the age of seventy-nine years. She joined the faculty as demonstrator of botany in 1891.

I. O. GRIFFITH, lecturer in mathematics and physics, since 1920 fellow of Brasenose College of the University of Oxford, died on September 22 at the age of sixty-one years.

To commemorate the one hundredth anniversary of the birth in 1841 of Dr. Eugene Allen Smith, who died in 1927 and who was for fifty-four years state geologist of Alabama, a meeting was held on November 1 in Smith Hall at the University of Alabama. Addresses were made by some of his old associates, and letters of appreciation from well-known geologists and mining engineers were read.

THE annual ceremonies commemorating the birth of Dr. Carlos Finlay, one of the investigators responsible for discovery of the transmission of yellow fever by mosquitoes, will be held in Havana early in December. The Ministry of Health of Cuba has announced that Vice-President Henry A. Wallace plans to be present at the ceremonies.

A FIVE-CENT stamp will be issued early in December to commemorate the work among the natives of Labrador and Newfoundland of Sir Wilfred Grenfell, who died on October 9, 1940.

## SCIENTIFIC EVENTS

### GIFTS AND BEQUESTS TO NEW YORK UNIVERSITY

IN the annual report of Dr. Harry Woodburn Chase, chancellor of New York University, it is reported that gifts and bequests to the university during the past academic year amount to \$664,268. These include \$60,282 from Bernard M. Baruch for the Samuel A. Brown professorship of therapeutics in the Medical College; \$47,049 from the estate of Eugene Stevenson, as unrestricted endowment; \$40,000 from the National Conservation Bureau for the Center for Safety Education; \$39,105 from the Commonwealth Fund for medical research; \$30,077 from the Sloan Foundation for the Educational Film Institute; \$30,000 from the Hayden Foundation for scholarships and loans; \$28,189 from the New York University Alumni Fund largely unrestricted, serving vital uses at many points not reached by the regular university budget; \$26,286 from the Rockefeller

Foundation for medical research and graduate teaching; \$22,267 from the Carnegie Foundation for the Advancement of Teaching for retiring allowances; \$18,036 from the estate of Emma Baker Kennedy for the Kennedy Endowment Fund; \$15,386 from sundry donors for research in therapeutics; \$10,400 from the Dazian Foundation for medical research; \$10,400 from Lucius N. Littauer for research in the College of Medicine; \$9,810 from the National Committee on Maternal Health for graduate research; \$9,655 from sundry donors for research in pneumonia; \$8,850 from Dr. F. H. Hirschland and others for graduate instruction; \$7,500 from Marshall Field for the university's division of the Welfare Hospital; \$7,500 from The John and Mary R. Markle Foundation for medical research; \$7,491 from the Josiah Macy, Jr. Foundation for medical research; \$6,878 from the Lederle Laboratories for medical research; \$5,100 from Standard Brands, Incorporated, and Frederick M. Stern, for nutritional research.

# THE NEW HALL OF ETHNOLOGY OF THE MUSEUM OF NEW MEXICO

THE new Hall of Ethnology of the Museum of New Mexico at Santa Fe was opened for the summer on July 1. *Museum News* reports that until an appropriation can be obtained for an adequate heating system the building must be closed during the winter months. The exhibits in the main hall and the storage in the basement have been installed; work still remains to be done on the Hall of Man. In the main hall, or Hall of Ethnology, emphasis is placed on the cultural attainments of the Indians of the Southwest. Nine alcoves line the north, west and south walls with exhibits of jewelry, weaving, basketry, leather goods, ceremonial items, paintings, a room in a Pueblo dwelling, pottery and cradle boards. Each alcove has its own theme and an independent story to tell, so that no placards of direction are needed. The cases are designed so that they serve as boundaries of the alcoves. The lower section of each is a storage compartment; and this brings the base of the exhibition section to 29 inches above the floor. The display ranges to four feet above this height. Cases are 12 feet long, all without shelving. Installations are made from the front of the cases. Props of various shapes, made of celotex over wooden frames, are used to support specimens. It is planned to have Indian craftsmen working in the alcoves. In the space in the center of the hall is a relief map of New Mexico seven and a half feet square, constructed by WPA draftsmen under direction of the U. S. Forest Service, showing life zones, highways, routes of early explorers, towns, pueblos, monuments, parks, forests and other features. From this map extends a series of low cases with model groups illustrating the life of Indian groups that have been important in the history of the Southwest. At the west end of the hall is a set of four Navajo sand paintings, made in the orthodox fashion. In the basement Indian pottery is stored in a room on shelves so adjusted that the vessels could be arranged according to their place of manufacture and in the same relative position as actual Indian groups, beginning at the East with Taos and Picuris. The room is well lighted and provided with tables and chairs for those who wish to study the material. Basketry, textiles, leather, jewelry, ceremonial material and miscellaneous material are treated in a similar way. In the Hall of Man the basic principles of anthropology will be illustrated. There will be busts illustrating early man and racial groups; exhibits illustrating evolution of tools, art, etc.; and graphic material. The Hall of Ethnology is under the direction of Miss Bertha P. Dutton, with Ernest Halyvi, of Mishongnovi pueblo, in charge of the building for the season.

# THE NEW YORK MUSEUM OF SCIENCE AND INDUSTRY AND THE HENRY R. TOWNE ENDOWMENT FUND

It is reported in the daily press that the trustees of the Henry R. Towne Endowment Fund have petitioned Surrogate James A. Foley for approval of their decision to discontinue payments of income to the Museum of Science and Industry and to distribute the remaining principal of \$1,630,010 in equal shares between the Museum of Natural History and the Metropolitan Museum of Art.

Mr. Towne, who was head of the Yale and Towne Manufacturing Company, died in 1924. He left his residuary estate in trust for the purpose of establishing a museum of peaceful arts. The Museum of Science and Industry was named income beneficiary and as such has received \$846,505 since the trust was established.

The trustees, John H. Towne, of Mount Kisco, N. Y., son of the decedent; Robert Struthers, Noroton, Conn., and the Bankers Trust Company, notified the income beneficiary on April 22 of their decision to discontinue payments to it and to distribute the principal, and the trustees have filed a final accounting, which they have asked the court to approve.

In his will Mr. Towne provided that

if the trustees, after having given due consideration to conditions, management and prospects of the museums, the executors and trustees, unanimously decided that in their judgment (and their judgment herein is to be final) it is inexpedient for them to make any further provisions of the museums or unwise to make any further advance, gift or disposition of the fund or its income, they might in their discretion pay over the principal in equal shares to the Metropolitan Museum and The Museum of Natural History.

The Museum of Science and Industry has filed an answer and cross-petition in which it is stated that the decision of the trustees to discontinue payments to it violates the intention of the testator and constitutes an abuse of discretion, and is arbitrary and capricious, void and illegal.

In its cross-petition it points out that in the last five years it had exhibited scientific and industrial works of the kind contemplated by the testator having an aggregate value in excess of \$3,000,000 to an average of more than 400,000 visitors a year.

The trustees in their report, which covers the period from November 26, 1929, to April 21, 1941, have accounted for a gross estate of \$3,594,432. The principal at the beginning of the accounting period was \$2,693,758. After payments to the income beneficiary, administration expenses and decreases, they had on hand on April 21 accounting a balance of \$1,-

630,010. Surrogate Foley will hold a hearing in the proceeding in January.

### THE NEW YORK MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

THE sixty-second annual meeting of the American Society of Mechanical Engineers will be held at the Hotel Astor, New York City, from December 1 to 5.

An extensive program has been prepared at which papers on the following subjects will be presented: Monday—vibration, power, work standardization, fuels. Tuesday—machine design, analysis of thin-walled structures, mathematical statistics, metals engineering, industrial instruments, power-hydraulic, boiler feedwater studies, mechanical properties of materials, machine shop practice, lubrication, heat transfer, national defense, aviation. Wednesday—plasticity, power session, textile, administrative organization, mechanical springs. Thursday—rubber and plastics, fluid mechanics, railroad, education and training, hydraulic, furnace-heat transmission, sugar, industrial marketing, materials handling, cutting of metals, marine power.

The annual dinner will be given on Wednesday at 6:30 P.M. William L. Batt will be toastmaster. Honors and medals will be presented to members and distinguished foreigners. The speakers will be William A. Hanley, president of the American Society of Mechanical Engineers and director of engineering of the Eli Lilly and Company, and Donald M. Nelson, executive director of the Seven Man Supply Priorities and Allocation Board. There will be a National Defense luncheon on Tuesday, a textile luncheon on Wednesday and a railroad luncheon on Thursday.

The sixth annual photographic exhibit is to be held as usual. This year it will be expanded to include all forms of graphic art, such as etching, pencil drawing, lithography, water colors, oil paintings, sculpture and so on. Medals of gold, silver and bronze will be awarded in all the various classes. The best photographs based on subject and reproduction possibilities will be used in *Mechanical Engineering*.

### RESIGNATION OF DR. ROY CHAPMAN ANDREWS AS DIRECTOR OF THE AMERICAN MUSEUM OF NATURAL HISTORY

DR. ROY CHAPMAN ANDREWS, since 1935 director of the American Museum of Natural History, New York, presented his resignation at the annual fall meeting on November 11 of the board of trustees. His letter, addressed to Dr. F. Trubee Davison, president of the board, reads:

For thirty-five years I have been connected with the American Museum of Natural History. For twenty-eight years I carried on almost uninterrupted field exploration in various parts of the world. Seven years ago political

conditions in China made it impossible to continue the Central Asiatic Expeditions in the Gobi Desert and upon the sudden illness of Dr. Sherwood, the director, I took over the administration of the museum.

The years that I was in the field were a period of expansion, the securing of invaluable collections and aggressive action for the museum in widely separated spheres. Chaotic world conditions have completely changed the picture. Even though funds were available it would not be possible to continue exploration except in a most limited degree.

As I see it, the museum, like many other institutions, is inevitably faced with a shift of emphasis in its activities. I have become the more convinced of this in conferences with Dr. Ruthven, who has been conducting the survey of the museum, which a year ago I requested the trustees to have made. The problems confronting the institution, particularly those dealing with its future financial requirements, are not those for which I am particularly fitted, either by inclination, temperament or training. I feel, therefore, that I am acting in the best interests of the institution when I ask the Board of Trustees to accept my resignation as director. I shall hope to maintain close relations with the museum and continue to serve it in other ways as long as I live.

### THE AWARD OF MEDALS OF THE ROYAL SOCIETY

ACCORDING to a special cable to *The New York Times*, the King of England has approved the recommendations of the Council of the Royal Society awarding royal medals for the current year to Professor Edward Arthur Milne "for his researches on the atmospheres of the earth and sun, on the internal constitution of the stars and on the theory of relativity," and to Professor Ernest Laurence Kennaway "for his investigations on the production of cancer by synthetic substances."

Dr. Milne, since 1928 Rouse Ball professor of mathematics and fellow of Wadham College, Oxford, is the author of "Relativity, Gravitation and World Structure," which suggested a new approach to the theory of relativity. Dr. Ernest Laurence Kennaway is professor of experimental pathology at the University of London and director of the Chester Beatty Research Institute of the Royal Cancer Hospital, London. He was awarded the Baly Medal in 1937 for his work in biological chemistry and cancer.

Other medals will be awarded as follows:

*The Copley Medal* to Sir Thomas Lewis for experimental researches in clinic and laboratory on the heart and circulation and their disorders.

*The Davy Medal* to Dr. H. D. Dakin, of Scarborough, N. Y., for pioneer work in biochemical research and his contribution to the study of intermediate metabolism.

*The Hughes Medal* to Professor N. F. Mott for application of the principles of the quantum theory to many branches of physics, especially the field of nuclear collision theory, the theory of metals and the theory of photographic emulsion.

## SCIENTIFIC NOTES AND NEWS

THE Bailey K. Ashford Award of \$1,000 and a bronze medal of the American Society of Tropical Medicine were presented at the St. Louis meeting to Dr. Lloyd E. Rozeboom, of the Johns Hopkins University, formerly medical entomologist of the Gorgas Memorial Laboratory at Ancon, the Canal Zone, in recognition of his work in tracing malaria transmission to a variety of mosquitoes suspected, but never demonstrated, to be a carrier of the disease.

THE *Journal* of the American Medical Association reports that Dr. Arthur E. Guedel, Los Angeles, was the guest of honor at a dinner given on October 21 by the section on anesthesia of the Los Angeles County Medical Association to mark the presentation to him of the Hickman Medal by the Royal Society of Medicine, London. At the dinner a representative of the British Government made the presentation on behalf of the Royal Society of Medicine. The principal address was delivered by Dr. Chauncey D. Leake, professor of pharmacology, lecturer in medical history and bibliography and librarian of the Medical School of the University of California.

A DINNER in honor of his sixtieth birthday was given by alumni to Dr. Champion H. Mathewson, professor of metallurgy and metallography and head of the department of metallurgy at Yale University. He was presented with a commemorative volume containing nineteen technical papers on physical metallurgy written by his former students.

PROFESSOR FRITZ HOFMANN, director of the Silesian Institute for Coal Research, has been awarded the Goethe Medal for Arts and Sciences in recognition of research work in connection with the production of synthetic rubber.

DR. ELMER L. SEVRINGHAUS, of the medical division of the Wisconsin General Hospital, University of Wisconsin, has been elected honorary foreign member of the National Academy of Medicine of Buenos Aires. Dr. Sevringhaus visited Buenos Aires last March and lectured there before the academy and other medical organizations as well as in Rosario and Montevideo.

AT the last meeting of the New York City Branch of the American Society of Bacteriologists held at Columbia University on October 28, the following members were elected to hold office in 1942: *President*, Professor E. J. Keegan, St. John's University; *Vice-president*, Miss Mary Horton, Sheffield Farms; *Members of the council*, Dr. E. R. Eaton, Welfare Hospital, Dr. D. M. Rogers, Borden Farms, and Dr. W. Reiner-Deutsch, Triboro Laboratories, *chairman*.

GEORGE C. THOMAS, JR., president of the Thomas and Betts Company, Elizabeth, N. J., was elected at the New York meeting president of the National Electrical Manufacturers Association. He succeeds Earl O. Shreve, vice-president of the General Electric Company.

DR. MILLISLAV DEMEREC, who since 1923 has been a resident investigator at the department of genetics at Cold Spring Harbor, L. I., of the Carnegie Institution of Washington and who has served as assistant director of this department for the last six years, has been appointed acting director, to take the place of Dr. A. F. Blakeslee, who retires on December 1.

It is reported in the *News Edition* of the American Chemical Society that Dr. Fred C. Koch, who recently retired as Frank P. Hixon distinguished service professor of biochemistry at the University of Chicago, will continue his researches in the field of endocrines at the Armour Laboratories, Chicago, where he will also act as consultant on research problems in biochemistry. A newly completed laboratory has been designated the F. C. Koch Laboratory and set up for his use in the chemical research department of the institute.

A DEPARTMENT of home economics research has been established at the Oklahoma College and Station with Dr. Williamina Armstrong, of the University of Illinois, as head. Dr. Armstrong will take over research in nutrition formerly conducted by Dr. Gladys Kinsman, who has resigned recently to become a member of the staff of the Women's College of the University of North Carolina at Greensboro. Research in home economics was previously administered under the department of agricultural chemistry research.

APPOINTMENTS at the Michigan College of Mining and Technology include Chester Russell, formerly a department head at the Universities of New Mexico and Denver, associate professor of electrical engineering; J. M. Crockin, assistant professor, and Dr. M. W. Bredekamp, instructor in chemical engineering and chemistry; A. B. Epple, Robert Hagen and E. W. Niemi, instructors in mechanical engineering; R. B. Oliver, instructor in metallurgical engineering; Fernando Paciotti, assistant research engineer in mineral dressing.

HELMUT R. R. WAKEHAM, of the Research and Development Department of the Standard Oil Company of California, has become associate chemist in the Section of Physical Chemistry of the Southern Regional Research Laboratory at New Orleans, La., of the U. S. Department of Agriculture.

C. FRED GURNHAM, a member of the department of chemical engineering of the Pratt Institute, Brooklyn, N. Y., has become associated with the firm of Fred S. Carver, New York City. He is conducting research on new applications of the operation of pressing, particularly in the field of vegetable fats and oils.

EDWARD GRAY, of the National Research Corporation, has been appointed biological chemist with Lever Brothers, Cambridge, Mass.

DR. A. EICHHORN, director of the Animal Disease Station at Beltsville, Md., recently visited England for consultations with the Ministry of Agriculture and the Agricultural Research Council.

DR. RICHARD S. BURINGTON, professor of mathematics at the Case School of Applied Science, has been granted leave of absence for the current academic year in order that he may continue his work as research mathematician and consultant in the Bureau of Ordnance of the Navy Department at Washington, D. C.

HENRY DYBAS, assistant in the Division of Insects of the Field Museum of Natural History, has returned to Chicago after collecting insects for three months in Mexico in company with Dr. Charles H. Seevers, of the department of zoology of the Central Y.M.C.A. College, and David Bergstrom. The party traveled by automobile and made stops of a few days or weeks at various localities which ranged from semi-arid country to luxurious tropical forest. Most of the collecting was done in the regions of Cordoba, Vera Cruz and the country to the south. The material obtained by Mr. Dybas numbers over 17,000 specimens. These are chiefly beetles, including three thousand fungus-dwelling beetles of the family *Ptiliidae*.

DR. VICTOR E. LEVINE, professor of biological chemistry and nutrition at the School of Medicine of Creighton University, has returned from the Arctic, where he spent the summer at King Island in the Bering Sea making vitamin C studies of Eskimo foods.

A GRANT of \$5,000 has been made to the Vanderbilt University School of Medicine by the S. E. Massengill Company, Bristol, Tenn., to be used for experimental purposes in the field of menstrual disorders by Dr. John C. Burch, associate professor of obstetrics and gynecology.

DR. SETH B. NICHOLSON, astronomer at the Mount Wilson Observatory of the Carnegie Institution of Washington, delivered on October 29 at the University of California at Los Angeles the Alexander F. Morrison Lecture of the Astronomical Society of the Pacific. His subject was "Sunspots and Magnetism."

At the meeting of the Philadelphia Section of the American Chemical Society, held on November 13 at the Franklin Institute, Dr. Colin G. Fink, head of the division of electrochemistry of Columbia University, gave an address on "Strategic Metals."

DR. THOMAS FRANCIS, JR., professor of epidemiology in the School of Public Health of the University of Michigan, will deliver on November 27 the second Harvey Society Lecture of the current series at the New York Academy of Medicine. He will speak on "Factors Conditioning Resistance to Epidemic Influenza."

DR. JAMES ALEX. MILLER inaugurated on November 13 the seventh series of the "Lectures to the Laity" of the New York Academy of Medicine with an address entitled "Tuberculosis: The Known and the Unknown." This constitutes the second Linsly R. Williams Memorial Lecture given in memory of Dr. Williams, who was the first director of the New York Academy of Medicine. A dinner to Dr. Miller preceded his delivery of the lecture. The Laity Lectures, six in number, are given one each month from November to May. They are open to the public and admission is free. Other lectures in the series are: December 11, "The Mechanisms of the Mind," by Dr. Tracy Jackson Putnam, professor of neurology and neurosurgery, Columbia University; January 22, "The Freudian Epoch," by Dr. A. A. Brill, lecturer in neurology and psychiatry, Columbia University (this is the New York Academy of Medicine Anniversary Discourse); February 26, "Creative Behavior in Child and Adult," by Dr. Arnold Gesell, director of the Clinic of Child Development, the School of Medicine, Yale University; March 26, "The History of Vitamin B," by Dr. Norman Jolliffe, associate professor of medicine, College of Medicine, New York University; April 23, "The Newer Knowledge on Nutrition," by Dr. A. J. Carlson, Frank P. Hixon distinguished professor of physiology, emeritus, University of Chicago.

At the eighth annual post-graduate day of the Medical Institute of the University of Toledo on October 31, instead of the usual program of prepared papers, the conference method was used. The subjects under discussion were "Digitalis—New Light on an Old Drug," "The Management of Heart Failure," "Circulatory Stimulants and Shock." There were three outside speakers, all from the faculty of the Cornell University Medical College—Dr. Eugene F. DuBois, Dr. Harry Gold and Dr. McKeen Cattell. All three speakers appeared at each session, the last half of each period being devoted to discussion. The first part of the session in the evening was devoted to a memorial to the late Dr. Lyman A. Brewer, who had served as professor of surgery and dean of the

Toledo Medical College. He was chief of staff at the time of his death at the age of seventy-seven years on January 16, 1939.

THE Fourth South American Chemical Congress, sponsored by the Chilean Government, will be held at Santiago in January. At that time the University of Santiago will celebrate its founding in 1504.

THE forty-third annual meeting, the two hundred and forty-sixth regular meeting, of the American Physical Society will be held at Princeton University on December 29, 30 and 31. The preliminary arrangements for the program include a joint session with the American Association of Physics Teachers for Tuesday afternoon. At this session it is hoped that President G. W. Stewart, of the State University of Iowa, will deliver his retiring presidential address, that Professor W. F. Magie, of Princeton University, will speak on the life work of Joseph Henry, and that Professor Arthur H. Compton, of the University of Chicago, will deliver the first Richtmyer Memorial Lecture of the American Association of Physics Teachers on "Wartime Problems of the Physics Teacher."

THE sixth annual meeting of the Florida Academy

of Sciences and the Florida Junior Academy of Sciences was held at Florida Southern College, Lakeland, on November 20, 21 and 22. In addition to the general sessions the academy met in three sections—Biological, Physical and Social Sciences. Sixty-one papers were presented. The program of the Junior Academy was held in the Lakeland High School building. Frank Brigham, superintendent of public instruction of Polk County, gave the address of welcome. There was a message from the Academy of Sciences, papers and demonstrations by members of the Junior Academy and a motion picture on vitamins in human nutrition by Professor L. L. Rusoff, of the university. Field trips, a football game and banquets for both academies were held.

PLANS for the construction by the General Electric Company of a plant to be built at a cost of \$1,000,000 for the manufacture of synthetic phenol have been announced by William H. Milton, Jr., the newly appointed manager of the plastics department. The action was taken to counteract a shortage of phenol, used by the government for production of plastic parts. The new plant is expected to be in operation in 1942.

## DISCUSSION

### THE POLARIZATION OF ATMOSPHERIC HAZE

THE article by George M. Byram in *SCIENCE* for August 22, pp. 192–193, seems to require some amendments in view of research I have conducted in the field of atmospheric polarization.<sup>1</sup> The statement, that "when viewed through a combination polarizing screen and red filter, the visual range of distant objects may be considerably increased, because under favorable conditions this filter combination removes a large part of the atmospheric haze," must allude to the presence of a light-colored object in front of a dark background.

The visual range is a function of the contrast between the sighted object and its background. Disregarding the influence of color and form contrast and other physiological factors, there is still the contrast between the apparent brightness of the object and its background to be considered. The apparent brightness of the object consists of the light reflected by the object and the light scattered by the air and its suspensions between the observer and the object, the so-called air-light. With regard to the apparent brightness of the background, two possibilities are encountered: If the background consists of a solid object, as, e.g., a mountain range, its apparent bright-

ness is a function of light reflected on it and the air-light. In case wooded mountains (albedo 0.07) form the background to a light object, such as a light-colored smoke column, an improvement can be obtained by viewing through a red filter and polarizing screen, since the short-wave air-light which is partially polarized is absorbed and thus the contrast between the light object and its dark background is increased. The same holds true for white clouds which have blue sky for a background, as the combination filter greatly reduces the short-wave, partially polarized, sky-light and thus allows the white cloud to stand out much better in front of the dark appearing sky. In these cases the improvement is in visibility rather than in visual range.

The other possibility under consideration is a dark object with the light from the clear sky near the horizon, the so-called horizon-light, as a background. In this case the resulting conditions are entirely different. The apparent brightness of the dark object is mainly a function of the air-light. The horizon-light consists of the light scattered by the air column from the observer to the boundary of the optically effective atmosphere, tangent to the earth's surface at the point of observation.

The air column involved in the production of the horizon-light is necessarily longer than that producing

<sup>1</sup> *Arch. d. Deutsch. Seewarte*, 56: 6, 1–53, 1936.

the air-light in front of the dark object. Moreover, light scattered in higher layers of the atmosphere contributes a large part to the horizon-light, whereas the air-light in front of the dark object is produced in surface-near layers where relatively greater quantities of large depolarizing particles are present. Therefore the degree of polarization of the horizon-light must be greater than that of the air-light. This statement is implied in results obtained by C. Dorno,<sup>2</sup> who found that the difference between the polarization of the horizon-light and air-light increases with increase in distance from observer to object. Thus the combination of red filter and polarizing screen absorbs more of the horizon-light than of the air-light, lowering the contrast and decreasing the visual range.

Numerous visual and instrumental (Wigand's visual range meter) observations made by the author through combinations of colored filters and Nicol's prism under all possible weather conditions did not reveal any improvement of the visual range when the horizon-light formed the background to the sighted object. In no instance, not even under the most favorable conditions, could a dark object with the horizon-light as background be made visible by any combination of filters if the object was not visible to the unaided eye on account of haze (in the meteorological sense), fog or dust. F. Löhle<sup>3</sup> showed on a theoretical basis that the effectiveness of filters is bound to certain limits of the ratio ( $\lambda/r$ ) of the wave-length ( $\lambda$ ) to the prevailing radius ( $r$ ) of the air particles. These limits within which an improvement of the visibility by means of filters can be expected are  $1.03 < \lambda/r < 5$ .

In the cases cited by Mr. Byram and those mentioned above where an improvement of the visibility is possible, the visual range is originally good. Therefore, the value of filters and polarizing screens for improvement of the visual range is negligible for all practical purposes.

If, however, the color contrast is of importance as, e.g., in spotting certain objects on the ground from airplanes, the use of suitable filters may greatly facilitate the identification of these objects.

HANS NEUBERGER

THE PENNSYLVANIA STATE COLLEGE

### SOME EFFECTS OF BINOCULAR VISION

FOR some years I have amused myself from time to time with experiments in the stereoscopic effects obtained by viewing objects and the landscape from different positions—that is, from upright and recumbent positions of the head. I am not a student of optics and I feel fairly sure that I have made no observations that are not well known to specialists,

<sup>2</sup> C. Dorno, *Veröff. Preuss. Met. Inst.*, No. 303, p. 253. Berlin, 1919.

<sup>3</sup> F. Löhle, *Meteorol. Zeit.*, 55: 54-61, 1938.

but conversations with friends have led me to believe that some of these effects are not very generally known, and I have thought it might be worth while to call attention to them.

We are so used to viewing things in the round by means of our binocular vision that we seldom stop to wonder at the really wonderful fact that so short a distance as that between the pupils makes it possible to judge the distance of an object even when its size is unknown and to see distant objects in their spatial relations with one another. A change in the position of the head, however, may open our eyes, so to speak. If we look at things, not in the usual way, but with the eyes in a vertical line, one above the other, we get a very different view. Now the trunk of a tree, for instance, is perceptibly flattened in appearance, but the individual branches are seen in the round, and this has the effect of emphasizing their horizontal lines, so that we feel that we have never really seen them before. A very good tree to try this experiment with is the white pine (*Pinus Strobus*) because of its habit of growth. Lying on my side in some pasture and looking at the pines along its border, I see the beauty of their horizontal branches as I never can when standing. The beauty of a mountain landscape, too, can best be appreciated from the recumbent position. As all mountain-lovers know, the wide-stretching views owe much of their charm to the successive shades of green and blue that rise one above another to the horizon. Probably only an experiment for himself will convince any one that these horizontal zones of color take on an added beauty when seen from a horizontal position, but seeing is believing, and it is an experience that I have often had. This emphasis of the horizontal lines, however, involves a corresponding suppression of the vertical lines, so that, as might be expected, the landscape thus viewed is noticeably flattened, and the summits appear to be considerably lower. Nothing is added to the grandeur of a towering peak, therefore, by taking the recumbent view of it. Indeed, quite the contrary is the case. But the beauty of wide-spread views of ranges and valleys is strikingly enhanced by this change in the position of the head.

Another experiment may be tried on a nearby ridge or a pasture slope across a dip. When one lies down, the slope appears to be rounded vertically, and, if it is a compound slope, every change in the pitch is accentuated. On the other hand, when one sits up or stands, the conformation of the ascent opposite is unnoticed, but every change in the horizontal contour is accentuated. Thus, if there should be a little brook or brook-bed running down that opposite slope, its course and the form of its banks would show much more clearly than they did when the observer was

lying down. If one looks at an evenly rounded hillock at a little distance, the horizontal convexity is evident when one's head is upright, and the vertical convexity shows itself when one lies down or holds the head sideways.

I have not exhausted the subject, but perhaps I have said enough to suggest to some readers a source of interesting and amusing personal experimentation.

FRANCIS H. ALLEN

WEST ROXBURY, MASS.

## THE OBLIGATION OF THE UNIVERSITIES

THE universities have, from all accounts, responded quickly and with a whole heart to the demands made upon them by the defense effort. In so doing they appear to have forgotten or to have disregarded their primary obligation to the community, as trustees of future leadership. With few exceptions, they have failed to insist upon deferment from military service of their graduate personnel, save in so far as such deferments are directly applicable to military defense. As a result, the personnel of those curricula from which immediate assistance is not needed is becoming seriously depleted. Many students of promise have been called into military service; others are shortly to be called; still others are transferring to departments in which deferment is likely to be had because of technological needs. The preservation of scientific research apart from its technological applications has seemingly received scant consideration. It is incumbent upon the universities to insist that this process of disintegration be halted before their primary function in the state is impaired, as it must be if deferment is not granted to promising candidates who would be expected presently to assume leadership and themselves direct the course of science.

We are faced with an emergency in more than a military sense. It is no longer a question of a year's service in a civilian peace-time army. It is now a question of the balance which must be struck between the various activities of the community as they affect our survival as a free people. It is a question of the intelligent direction and employment of human resources to achieve not only the military decision which we must achieve, but the utilization of it when the military effort is no longer needed. It is, I am convinced, now a question of the survival of science itself.

Science is an integrated whole. It is not physics and biology and chemistry. It transcends these disciplines and many more. It is a view of life and human effort based upon a continuous body of information which is being and must be constantly augmented. Its essence is the essence of democracy: of the free inquiry of individuals and the worth of individual judgments which are based upon observed

and demonstrable fact. It is the very brain and nerve-center of our American civilization. Its antithesis is authoritarian dogma. It is a fragile fabric which depends upon warm human contacts from generation to generation. It can not be embalmed in printed words which later generations can discover in some tomb. It is a process, living and continuous, which rests not alone upon the research of a given master but upon the continued sharing of his experience and skills with the apprentice.

We are engaged in a struggle which is to determine whether our way of life and the scientific approach which is its base shall survive. The military effort is the present aspect of this struggle. In the long run it is not the decisive one. It can do no more than secure the ground over which a future more rational advance can be made. But it, no less than the non-military activities of the community, is finally dependent upon the resources and authority of science. Should army service be permitted seriously to deplete the oncoming personnel of science, particularly those to whom the universities and the community must look for leadership, its legitimate and mandatory activities will disappear and technology will wither at its source. We shall face the far-reaching consequences of a lost generation of leaders. The last war was won by a generation which was lost, and with their loss was lost the peace of Europe which it was their tragic responsibility to organize. To disorganize scientific research now is to place in jeopardy the military victory, to handicap it is to handicap the whole struggle for the community, both in prosecuting the war and in procuring the peace.

The community has invested heavily of its time and wealth in these young men in order to fit them for leadership in highly specialized and vital callings which few are equipped to undertake. I can not believe that the best interests of the community are to be served by deflecting exceptional students from the course upon which they have been set in order to make a transitory contribution which in many cases can be done more effectively by others of different temperament. Their specific knowledge and skills, continually augmented, may be of immediate and practical use in ways as yet unseen. The utility of scientific information is unpredictable. The curtailment of their training over any extended period will mean far more than the cessation of activities to be picked up again at the same point; a positive loss will inevitably have been incurred which it may be psychologically impossible to regain. The future effect of such loss upon both civil and military needs is incalculable.

CARL EPLING

UNIVERSITY OF CALIFORNIA  
AT LOS ANGELES

## SPECIAL CORRESPONDENCE

## PHYSICS IN PRE-NAZI GERMANY

GERMAN physics has occupied a prominent position in science during the last century. A big role in all the discoveries in the field of physics during the nineteenth century and the first quarter of the twentieth century was played by German physicists, particularly renowned among whom are Robert Mayer, Gustav Kirchhoff, Rudolph Clausius, Herman Helmholtz, the physicist, physiologist and physician, and Ludwig Boltzman.

Characteristic features of nineteenth century German physics were breadth of conception and the ability to solve major scientific problems.

The solution of these problems followed two trends. Albert Einstein elaborated his theory of relativity, the profundity and significance of which may be compared in the history of physics only with Newton's elaboration of the theory of mechanics. It was subsequently developed by other scientists, among whom we find the German mathematicians Minkovsky and Weil. On the other hand, we have the teaching of the structure of the atom—the smallest particle of matter—which was developed by both experimenters and theoreticians and which led to the elaboration of the famous quantum theory. At first this was the so-called old quantum theory in which the quantum principles were expressed in the simplest form. They proclaimed the necessity of regarding light, at one and the same time, as both a continuous substance and as an accumulation of discrete particles. For the scientists of those times who were not inclined to think dialectically this signified a revolution in their whole system of reasoning.

This theory was elaborated by Max Plank and Albert Einstein. In the following twenty years it was rapidly developed, at first in the work of the Danish physicist, Nilson Bohr, and the German physicist, Arnold Sommerfeld. It was then reconstructed anew and transformed into modern quantum mechanics (in point of fact, this marked the creation of a new science) by such famous physicists as Irvin Schrodinger and Werner Heisenberg. This theory has entered the arsenal of modern technology and has led to numerous remarkable discoveries.

## MODERN GERMAN PHYSICS

Theoretical physics is declared by the Nazis to be "Jewish physics." This meaningless combination of words is supposed, in the opinion of the crassly ignorant Unteroffiziers, to signify the harmfulness of science, while as far as the scientists of Germany are

concerned a "veto"—complete and utter—has been placed on their fruitful work in this field.

There appears the disgraceful book by Philipp Lenard, "Germany and Jewish Physics," in which it is "explained" that German physics is created by "the German popular spirit which is unoverburdened with erudition."

The "principle" of the racial dependence of scientific knowledge, in accordance with which all correct scientific results belong only to Aryans, is taken seriously as the supreme criterion in judging one or another physical theory. This "principle" asserts that even the "conception of the fact that two times two is four takes on different hues in the minds of the German, the Frenchman, Negro and Jew (from an article in *Natur*, December 7, 1940).

With Hitler's advent to power Albert Einstein is described as follows: "The American Jew Michelson and the vile Jew Einstein received the Nobel prize from the Swedes, who have sold their race."

This citation is taken from the German magazine *Grenzland* of 1934, in which in a letter to K. Rosenberg "Doctor" Eric Roskote lists W. Heisenberg's sins before "Aryan physics."

Urban, "councillor of higher schools" came out with a reply to the letter, "explaining" that "Einstein's theory is pure dupery and has no other purpose than to befool Aryans."

The physicist I. Stork, the director of the Reich Institute of Physical Engineering, at the opening of the institute in Heidelberg, presented an equally authoritative characterization of theoretical physics—"Jewish physics" and its "high priest," A. Einstein. Stork proposed that the science chairs and the guidance of science be handed over to "the true German SS's of science" and that all the great physicists be driven out of Germany.

One after another the most prominent physicists left Germany. Some were hounded out of the country because of their race, others are demonstratively refusing chairs and flee before reprisals can be taken against them, as Dr. Frank did on the day that the Nazis seized power. Dr. Frank was professor of physics in the Göttingen University since 1920. At the present time he is working in Chicago (*SCIENCE*, Vol. 87, 456, 1938).

The renowned physicists Bloch, Boethe, Haitler, London, Paiphes, Plachek, Wigner and Weiskopf, known for their brilliant work on the application of quantum mechanics to various concrete physical problems, have been driven from Germany. Bloch elabo-

rated the principles of the theory of metals and explained a number of their properties. It was he, too, who explained a number of the properties of ferromagnetites. Bloch, Boethe and Haitler explained a number of the effects of the passage of rapid, charged particles through an element. Their work forms the foundation for the comprehension of all the phenomena taking place in the cosmic rays. Boethe and Paiphes are likewise known for their work on the theory of the atomic nucleus and on the physics of crystals. Haitler and London have explained the properties of chemical forces. Their work in this direction plays an important role in the study of the colossal amount of facts pertaining to chemical reactions. Plachek, Wigner and Weiskopf have worked up the theory of dispersion of light and have done important research in atomic nucleus physics.

The Aryan physicists—Heisenberg and Sommerfeld and others—who remained in Germany found themselves hounded. For recognizing modern science and especially for recognizing the “non-Aryan” theory of relativity, they were given the sobriquet of Weisse Juden. Sommerfeld was compelled to give up his chair in the University of München, where for over thirty years he had trained a brilliant group of young physicists.

As a result German physics lost its leading role in world science.

In Fascist Italy, too, the same thing took place. Fermi, the Nobel prize winner, fled from Italy; Bruno Rossi was expelled from the University of Padua by special decree in September, 1939. Rossetti, Segré and others likewise fled from their native land—Italy!

Before the advent of the Nazis the German physical journals (*Zeitschrift für Physik*, *Annalen der Physik*, *Physikalische Zeitschrift*) had always served as the central organs of world science in this domain. The campaign of the Nazis against German science caused these journals to turn into meager notebooks frequently filled with third-rate work by the few physicists still remaining in Germany. The biggest of these journals, *Zeitschrift für Physik*, for instance, publishes two and one half issues a year instead of the six to seven issues it normally published in the 'twenties. In its time this journal attracted scientific papers from all over the world. In 1930 approximately 700

scientific papers were printed in its seven volumes, of which 280 were by foreign scientists (including about 80 by Soviet scientists). In 1938 only about 150 papers were printed, of which about 50 were by foreign authors. Thus this journal, once the central organ of world physics, has been transformed into a provincial journal. The following facts are very indicative. If we take the American journal *Physical Review*, which to this day serves as one of the most important scientific organs, and calculate the number of times German papers are cited in it we shall find that in 1932 about 35 per cent. of all the references referred to papers published in Germany. In 1939 only 15 per cent. of the references were to German papers, and even of these many pertained to papers written before the Nazis seized power.

The German physical journals are forced to publish such “scientific papers” as Stork’s article: “The Structure of the Electron and Super-Conductivity.” From the very first lines of this article it is obvious that the author tries to refute the modern theory of quantum mechanics. Although he asserts that the theory must be combined with experimental work he himself makes no attempt to base himself on modern experimental data.

Stork once received a Nobel prize in the past, but being connected with the ceramics industry it is many years since he has been working in the field of physics and he is therefore more than a quarter of a century behind modern physics. And it is Stork and Lenard who are Führers of “German physics.”

Nazism has wreaked the same havoc with science in the territories which it has conquered.

An item in *Natur* (3711) points out that the dismissal of rectors and deans from the Czech universities by the German authorities shows that these universities, which have been closed for three years, will never be reopened.

In an article on German Kultur in Czecho-Slovakia *Natur* (No. 3706 of November 9, 1940) writes that the books and valuable appliances were removed from the Czech universities or simply squandered. The splendid equipment of the Institute of Physics in Poland also, as we know, met the same fate.

CORRESPONDENT IN USSR

## QUOTATIONS

### THE NUTRITION SOCIETY

ELSEWHERE in this issue we publish particulars of the newly formed Nutrition Society. In giving it, as we do, a whole-hearted welcome, we are not to be taken as either assenting to or dissenting from any

general proposition about the desirability of forming new scientific societies—even in peacetime. For such projects to be praiseworthy at least two conditions must be satisfied. First, the subject of the new society’s activity must be of importance—as the patent lawyers might say, it must have “content”; secondly,

there must be no other existing society that can cover the whole of the same ground equally well. On the second issue the new society can claim general support. The scientific attack on nutrition is, indeed, made from many directions—by medical practitioners, biochemists and physiologists, agriculturists and veterinarians, dietitians and sociologists, economists, statisticians, food technologists and probably others. In the specialized organizations to which these various experts belong questions of nutrition will be discussed with less or greater frequency. Indeed, in medical organization the attention given to dietary factors is certainly still on the increase. But even here, and in the excellent meetings arranged through its Nutrition Panel by the Food Group of the Society of Chemical Industry, it is obvious that there is a lack of integration. At the medical gathering the biochemist and laboratory worker are likely to be in the background, the agronomist and the practical dietitian probably entirely absent; at the Food Group meetings medical views are unlikely to be represented, and veterinarians are probably as invisible as statisticians. If the new society can bring together all the contributors to our growing knowledge of the relationship between food and health it will certainly achieve something not yet achieved—primarily, perhaps, because it has never been attempted, at all events in this country. And it has so far not been attempted because the importance of the subject is still too little appreciated in many of

the most influential circles. It is doubtful if the emphasis given to-day to problems of feeding the community would have been nearly as marked but for the exigencies of wartime. In this sense, but we are sure in no other, the Nutrition Society may possibly be considered a child of Hitler. There can be little doubt to-day—least of all in the minds of medical practitioners—that nutrition has become a subject with “content.” For the investigations of nutritional problems, special and other new techniques have been increasingly needed; for the discussion of problems and techniques alike a new organization has been found necessary.

That there are many gaps—some of them enormous—in our knowledge of human and animal nutrition would not be denied by the most craft-conscious nutritional scientist. The meetings or conferences to be organized by the new society—if one may judge by the proposed Cambridge meeting on “The Evaluation of Nutritional Status”—are just of the type calculated to reveal these gaps and therefore to point to ways of closing them. In that sense, if in no other, the foundation of the Nutrition Society may legitimately be regarded as a contribution to the national war effort, for it can not fail to give support to all those forces that, by stimulating investigation and helping to disseminate its results, make for improvements in the dietary of the people as a whole and therefore in their health, their vigor and their democratic independence.—*The British Medical Journal*.

## SCIENTIFIC BOOKS

### THE HARVARD BOOKS ON ASTRONOMY

TWENTY years ago Harlow Shapley became the director of the Harvard College Observatory. A young man himself (then only 36), he chose other young men to work with him. As director he elected to delegate to the younger men responsibility for plans as well as for execution of the plans. He encouraged them to undertake research and found the money to support their projects. As the years have passed, he has brought to Harvard Observatory that air of critical, original thought, that intellectual ferment that can perhaps best be described as an “atmosphere of research.”

Realizing the need for a series of modern authoritative books on the various fields of astronomy which might be read by laymen, beginning students and amateur astronomers, he set his men to work. Nine books were planned, and fourteen authors have been writing them. In each case, the authors were chosen

because of their competence in the particular field. Serving as editors are Dr. Shapley and one of his young men, Dr. Bart J. Bok; this may be taken as a guarantee of the quality of the books. The Blakiston Company of Philadelphia is publishing the series.

The first four books of the series have appeared. If the later volumes maintain the high standard set by these four, the series will be an outstanding success. The volumes at hand are attractively bound in a red water-resisting material. Each has 200 or more pages of clear easily read print and excellent illustrations. Especially to be commended is the generous use of photographs of astronomers, past and present, each picture appearing near the point at which the man's work is mentioned in the text.

The progress of astronomy is so rapid that it is difficult to publish a book that is truly up-to-date. These volumes are! Furthermore, they are inexpensive and readable; they may be read with pleasure and profit by any person with a high-school education.

*The Milky Way.* By BART J. BOK and PRISCILLA F. BOK. 204 pp. 96 illustrations. Philadelphia: The Blakiston Company. 1941. \$2.50.

This book presents clearly an excellent summary of our present knowledge of the Milky Way and explains how that information was gathered. It also points out some of the problems which remain to be solved. It explains how the astronomer interprets his star-counts and why international cooperation in the field is so important. The book is a very readable one, one interesting idea leading directly to another. As evidence that the book is up-to-date, mention might be made of the automatic star-counter of McCuskey and Scott, and the use as illustrations, of photographs taken with Schmidt cameras.

The reader may be misled by the modesty of the authors; the name, Bok, does not appear in the index and the personal pronouns, first person, seldom appear in the text. Their contributions to the field are mentioned but without credit to them or to Harvard Observatory. There should be some way of informing the reader that the Doctors Bok are authorities in the field in which they write. This comment applies also to the other three books reviewed here.

One can get a glimpse of the authors in their choice of words; colorful phrases, such as "Siberian wastes of intergalactic space," "ectoplasmic glow" and "leaking quantum" appear occasionally. Some persons will criticize the book because the term, "light year," is used on page 17 and defined on page 31; because "proper motion" is used on page 38 and explained on page 65. However, a second reading, which the book well deserves, will take care of such small difficulties. After reading on page 40, ". . . since light is a wave-motion . . ."; on page 112 of "light quanta" and on page 131 of a "quantum of wave length 3933, Angstroms," the reader may feel that the authors should have said specifically that astronomers are unable to choose between the wave theory and the quantum theory of light.

There is an index at the end of the book which is generally satisfactory. It may be noted that the important word, "parallax," does not appear there; under "stellar," one finds several kinds of parallax listed but not the basic "trigonometric parallax." In a small pocket in the back, there are two excellent composite photographic maps of the Milky Way, Northern and Southern, which may be removed for examination.

*Between the Planets.* By FLETCHER G. WATSON. 222 pp. 106 illustrations. Philadelphia: The Blakiston Company. 1941. \$2.50.

This volume covers the asteroids, comets, meteors and meteorites and discusses briefly the zodiacal light and the Gegenschein. It is natural for an author to emphasize those things in which he is particularly interested; approximately one fifth of this book is about asteroids, one fifth about comets and three fifths about meteors and meteorites. It should appeal especially to statistically minded persons, for there are many graphs, scatter diagrams and tables. To be specific, there are about thirty tables, fifty charts, graphs and diagrams and sixty photographs or pictures.

Mathematicians will be critical of some of the statements appearing in the book, as, for example, on page 4, "Elliptical orbits can be of all shapes and sizes," and on page 6, "If it moves faster, the orbit is a hyperbola having an eccentricity larger than one and, according to the mathematicians, a period greater than infinity. . . ." Elliptical orbits are always closed curves and except for limiting cases, oval in shape; the mathematician's definition of "infinity" does not allow anything to be "greater than infinity." On page 53, the author uses the phrase, "moderately circular" and in the legend of Figure 40, page 72, "extremely circular." Circularity is somewhat like perfection; it is not subject to qualification.

One wonders why, after using good American phrases throughout the book, the author should choose to use "million million million" instead of "quintillion" or, if necessary, "American quintillion." The reader will be aware that the proofreading was poor. If the author had had an opportunity to correct a second proof, the book would have been improved. Fortunately, there are few places where scientific accuracy of statement is endangered by typographical errors.

When the reviewer was in college, he was not allowed to write two complete sentences and separate them merely by a comma. The author allows himself this privilege frequently. Investigation reveals that some of the most recent text-books on English allow such "run-on" sentences. Thus the English, as well as the information in this book, is the very latest.

After these critical comments, it may be wise to say again that the book will be interesting to any one wanting to know more about asteroids, comets, meteors and meteorites.

*The Story of Variable Stars.* By LEON CAMPBELL and LUIGI JACCHIA. 226 pp. 82 illustrations. Philadelphia: The Blakiston Company. 1941. \$2.50.

This volume covers well the field of variable stars—discovery, observation and theory; short-period, long-period and irregular variables, novae and eclipsing

binaries. It is well written and reflects the authors' enthusiasm for their subject as well as their knowledge of it. The senior author has been a guiding light of the American Association of Variable Star Observers for many years. One may confidently predict that every member of this organization will want a copy of the book, as will other amateurs who are looking for observational work to do.

The authors stay close to the subject in hand, though on page 98, one is reminded of the difficulty of throwing a twelve with a pair of dice and on page 113, Samson and Delilah are introduced. It is pleasant to find specific figures given, as for example, the shortest and longest periods known for a given type of variable star. One is encouraged to learn on page 131 that it is improbable that our sun will explode, a possibility to which too much space has been given in our newspapers.

For a horizontal inflexion point, the authors use the word "still-stand," presumably because there is no better English word for it. They might have used the initial letters of "horizontal inflexion point," thereby giving a new and descriptive use to an old word. The characteristic curve of a photographic emulsion has a "toe" and a "shoulder"; why shouldn't an occasional light-curve of a variable star have "hips"?†

At the end of the book are given the following tables: Names of the constellations and their abbreviations; Table for conversion of decimal of a day to hours and minutes; Julian Day Table 1940-1950; Twenty interesting variable stars; Fourteen interesting Novae.

*Earth, Moon and Planets.* By FRED L. WHIPPLE. 293 pp. 140 illustrations. Philadelphia: Blakiston Company. 1941. \$2.50.

This lucid book has a freshness which is amazing when one considers the large number of books which have been written about the solar system. The field covered is adequately described by the title. One finds the true spirit of science in the impersonal manner in which the evidence bearing on a given theory is evaluated and in the breadth of mind reflected in the phrasing of conclusions drawn from that evidence.

Every chapter in the book is interesting, but the discussions of "The Earth as an Abode of Life" and of Mars are of especial interest. In contrast to the other three books reviewed above, metric units are not used, nor is temperature given on the Centigrade scale. The average American reader will find miles and degrees Fahrenheit easier to understand than kilometers and degrees Centigrade. One can read this book with pleasure and understanding, even though one has no scientific background.

Some readers will dislike the use of many footnotes; the presence of a dagger or an asterisk at the end of a sentence does interrupt the smooth continuity of a paragraph. Others may take exception to the spelling of some words, such as "clews" and "crape," and to the use of "island universe" for a spiral nebula. Those making the latter criticism will insist that though "island universe" has been widely used, by definition there is only one universe and it includes the spiral nebulae.

In a small pocket in the back of the book, there is a good star-map covering the region of the sky within 65 degrees of the celestial equator. This is convenient, since one does not need to take the whole book out into the garden when one wishes to study the stars. No maps are given for the regions near the celestial poles. One unusually valuable feature of this book is the Planet Finder, with which one can determine the approximate locations in the sky of the Sun, Mercury, Venus, Mars, Jupiter and Saturn at any time between 1940 and 1970, inclusive.

CHARLES H. SMILEY

BROWN UNIVERSITY

### CALCULUS OF EXTENSION

*The Calculus of Extension.* By HENRY GEORGE FORDER. xvi + 490 pp. Cambridge: At the University Press. New York: The Macmillan Company. 1941. \$6.75.

THIS book gives an account of the use of Grassmann's Calculus of Extension in geometry. The abstract algebra, which is *The Calculus of Extension*, is developed postulational and is applied in a variety of geometric situations.

The treatment advances from the special to the more general. Chapter I is devoted to "Plane Geometry," and Chapter II to "Geometry in Space." Chapter III is concerned with "Applications to Projective Geometry," and "The General Theory" begins with Chapter VII. In all there are fifteen chapters, treating among others such further topics as "Rotors in Space, the Screw, and the Linear Complex" in Chapter IV, "Circles" in Chapter XI, and "Transformations and Square Matrices with Applications to Central Quadrics" in Chapter IX.

Much of the material included is classic. However, a characteristic of this work which is due to the author is the emphasis on identities. His aim is "to express geometric theorems as identities, involving not co-ordinates but the geometric entities themselves which appear in the theorems."

The author is professor of mathematics in University College, Auckland, New Zealand. He comments in the Preface upon the unfavorableness of his environment to scholarly endeavor, noting particularly

a dearth of good mathematical libraries. It would seem that this book which he has written is especially well adapted to the needs of students where a good mathematical library is not readily accessible. To master this volume would imply an algebraic and geometric education of no mean order. However, if the author had been writing in the United States, where students acquire in courses in higher algebra a reasonably good mastery of this subject, he might have been disposed to devote less space to certain

algebraic subjects, for example, "The General Theory of Matrices," to which Chapter XIII is devoted.

In writing this book the author has served the cause of geometry well. Students of geometry wherever English is spoken will find this a practicable reference for the topics discussed and the method employed. The author has succeeded in his purpose "to show the algebra at work, to illustrate its power and its range."

ERNEST P. LANE

UNIVERSITY OF CHICAGO

## SOCIETIES AND MEETINGS

### THE SECTION OF PSYCHOLOGY OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION I (Psychology) of the American Association for the Advancement of Science will meet in Dallas, Texas, on Monday, December 29, and Tuesday, December 30, as part of the general meeting of the American Association for the Advancement of Science which extends from December 29 through January 3.

In addition to the usual program of contributed papers there will be, on Monday, December 29, a symposium on "Recent Advances in the Appraisal of Personality" under the chairmanship of Professor Ernest R. Hilgard, of Stanford University, and on Tuesday, December 30, a joint symposium with Section Q (Education) on "The Psychology of Learning and the Educative Process."

It is hoped that a large number of psychologists will attend and participate in the Dallas meetings. The character of the general program must depend on the submitted papers, and all psychologists are urged to send in abstracts. Both theoretical and experimental papers are acceptable.

Psychologists who wish to read papers should submit abstracts in duplicate (not more than 300 words in length). Please note on the abstract the time required for presentation up to a limit of 15 minutes, and also whether a slide projector or moving picture projector

will be required. Abstracts should be sent to the Chairman of the Program Committee, Professor John A. McGeoch, Department of Psychology, State University of Iowa, Iowa City, Iowa, so that they will be received not later than November 15, 1941.

The meetings of Section I of the American Association for the Advancement of Science offer to psychologists not only an opportunity to participate in meetings of their own, but also to become acquainted with current investigations and investigators in other sciences. The activities of Section I can do a great deal toward establishing the place of psychology among the sciences, toward cementing friendly relations with related sciences, and toward increasing the influence and usefulness of psychology. It is hoped that many among the members and associates of the American Psychological Association who are not now members of the American Association for the Advancement of Science, and through it of Section I, will join the American Association for the Advancement of Science and participate in its meetings. By so doing they will be supporting the advancement of science in general and of psychology in particular. The secretary of Section I will be happy to receive and endorse applications of members and associates of the American Psychological Association, and to answer questions concerning the work of Section I.

ARTHUR W. MELTON, *Secretary*

UNIVERSITY OF MISSOURI

## SPECIAL ARTICLES

### PURIFICATION OF THE VIRUS OF MOUSE ENCEPHALOMYELITIS (THEILER'S VIRUS)<sup>1</sup>

BEARD and his collaborators<sup>2</sup> were able to purify the virus of equine encephalomyelitis and that of rab-

bit papilloma by differential centrifugation of infected tissue extracts. Working with encephalomyelitis virus in chick embryos, they observed, however, serious disturbances of the purification process, unless the brain and chord were removed from the embryos before preparation of the extracts.

The study on the virus of mouse encephalomyelitis to be reported here was made with the highly virulent FA strain of the virus.<sup>3</sup> Infected mouse brains served

<sup>1</sup> This study was made with the aid of a grant from the King of Sweden's Birthday Fund for Prevention of Disabling Diseases.

<sup>2</sup> H. Findelstein, W. Marx, D. Beard and J. W. Beard, *Jour. Inf. Dis.*, 66: 117, 1940; and J. W. Beard, W. R. Bryan and W. G. Wyckoff, *Jour. Inf. Dis.*, 65: 43, 1939.

<sup>3</sup> M. Theiler and S. Gard, *Jour. Exp. Med.*, 72: 49, 1940.

as starting material, and the difficulties mentioned by Beard were very obvious. The large quantities of slowly sedimenting, coarse material (cellular structural elements rich in lipoids and lipoproteins) present in the extracts rendered purification by means of differential centrifugation impossible. Attempts to obtain more suitable solutions through digestion with pancreatic juice were not successful. The purification procedure, finally adopted, was as follows.

Five hundred mouse brains are ground with sand and 0.05 M sodium chloride solution is added to make a total volume of 3,500 ml. The coarse material is allowed to settle overnight in the cold room. The supernatant extract is then siphoned off and vigorously shaken with two thirds by volume of ether. The mixture forms an emulsion, which, however, soon separates into two distinct layers, an aqueous one containing practically all the original activity and an ethereal top layer, in which most of the lipoids are to be found. The bottom layer is collected and one half by volume of saturated ammonium sulfate is added. A voluminous precipitate, containing more than 99 per cent. of the activity, is formed, rapidly rising to the surface. This precipitate is collected, washed in a separatory funnel with one third saturated ammonium sulfate solution, and finally extracted with distilled water. It is important that the ether should not be removed until the extraction is completed, otherwise the lipoids, still present in the precipitate, will be emulsified and the extract thus be unsuitable for further purification. The aqueous extract, faintly yellow in color and almost clear, is concentrated by means of ultrafiltration as described by Seibert,<sup>4</sup> washed on the filter with distilled water until free from salt and ether, and finally fractionated in an air-driven high-speed quantity centrifuge at 11,000 and 22,000 r.p.m. After 3 to 4 fractionations the solution is usually free from fast sedimenting material, and gives by centrifugation for 2 hours at 22,000 r.p.m. a small pellet, homogeneous, yellowish brown and readily soluble in distilled water. If optical methods are to be applied in the further analysis, the final volume of the preparation should not exceed 1 ml. All operations indicated above should be performed at a temperature below 8° C.

The preparations, purified according to this method, retained 30 to 50 per cent. of the original activity, corresponding to an increase in activity per unit of volume of about 1,000 times. The sedimentation constant of the virus was determined in two ways.<sup>5</sup> By optical analysis of purified material in the ultracentrifuge three components could be distinguished with sedimentation constants  $s_{20}$  of about 40, 160 and

210  $\times 10^{-13}$ . In similarly treated normal mouse brain only two of these were present and no traces of the middle component with the sedimentation constant  $s_{20} = 160$  could be detected. In the active preparations the concentrations of the three components were nearly equal, corresponding to about 0.5 mg per 100 g of mouse brain.

Furthermore, crude extracts as well as partially purified material were spun in the separation cell<sup>6</sup> and activity determinations performed on the contents of the outer and inner compartment. The sedimentation constant was calculated to be 160 to 170  $\times 10^{-13}$ . It seems, therefore, highly probable that the medium component, present in active material only, really represents the virus protein.

On one preparation, consisting of the virus component in practically pure state, a determination of the diffusion constant was attempted. The accuracy of the value observed,  $D_{20} = 0.27 - 0.33 \times 10^{-7}$ , must be regarded as somewhat questionable on account of the small quantity of material available. On the assumption of a specific gravity of 1.33 the diffusion constant 0.30 corresponds to a molecular weight of  $52 \times 10^6$ . If one further assumes ellipsoidal and unhydrated molecules, the axial ratio can be calculated to be 46:1 and the actual size  $640 \times 14$  m $\mu$ . Beard and his collaborators<sup>7</sup> found, however, in another neurotropic virus, that of equine encephalomyelitis, a large proportion of lipoids and a correspondingly low specific gravity of 1.19. On the basis of this latter value the figures in the case of mouse encephalomyelitis virus would be  $M = 81 \times 10^6$ , the axial ratio 31:1 and the size  $590 \times 19$  m $\mu$ . In all figures given above the error might amount to  $\pm 20$  per cent. For comparison it might be mentioned, that Theiler and Gard by means of ultrafiltration determined the particle diameter to be 9 to 13 m $\mu$ .

The observation by Armstrong<sup>8</sup> of murine strains of the virus of human poliomyelitis has augmented the importance of the study of that of mouse encephalomyelitis and its possible relationships to the human virus. The results reported here, seem to indicate new ways for approaching this problem. A study along these lines has been started, the results of which will be published elsewhere.

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<sup>6</sup> A. Tiselius, K. O. Pedersen and T. Svedberg, *Nature*, 140: 848, 1937.

<sup>7</sup> D. G. Sharp, A. R. Taylor, D. Beard, H. Finkelstein and J. W. Beard, *Science*, 92: 359, 1940.

<sup>8</sup> C. Armstrong, *Pub. Health Rep.*, 54: 1719, 1939; C. W. Jungeblut and M. Sanders, *Jour. Exp. Med.*, 72: 407, 1940.

<sup>4</sup> F. B. Seibert, *Jour. Biol. Chem.*, 78: 345, 1928.

<sup>5</sup> Sedimentation and diffusion experiments were always carried out at 0° C. and the constants corrected as usual.

# THE CARCINOGENIC EFFECT OF METHYLCHOLANTHRENE AND OF TAR ON RABBIT PAPILLOMAS DUE TO A VIRUS<sup>1</sup>

WESTERN cottontail rabbits frequently carry on the skin large epidermal papillomas caused by a virus,<sup>2</sup> which have the immediate character of neoplasms.<sup>3</sup> The growths closely resemble in structure and behavior the papillomas of unknown cause which are elicited on rabbit skin by tar and methylcholanthrene,<sup>4</sup> and after growing for a while they sometimes become carcinomatous,<sup>5</sup> as do these latter, undergoing histological changes of the same sort then, with result in malignant tumors of like kind. As bearing on the theoretical possibilities, it has seemed desirable to learn whether chemical carcinogens will cause virus papillomas to become cancerous.<sup>6</sup>

Two groups of domestic rabbits were inoculated with papilloma virus from different sources by rubbing it into four to six scarified areas of skin; and as soon as healing had taken place tar and 0.3 per cent. methylcholanthrene<sup>7</sup> were applied to some of the inoculated areas, while others on the same animals were painted with the solvent as such, or with a mixture in equal parts of turpentine and acetone which had been previously tested and found mildly irritant and non-carcinogenic for normal rabbit skin.<sup>8</sup> Untreated papillomatous areas served as further controls. The applications were repeated thrice weekly and were kept up for 2 to 4½ months, with stripping away from time to time of the keratinized layer overlying all the growths. Fifteen rabbits survived to the end of the tests. In no instance did cancer develop from the untreated papillomas or from those receiving ether and paraffin oil or turpentine and acetone, though this last mixture induced notably vigorous proliferation of the growths. In contrast with these results, malig-

nant changes not infrequently occurred in the papillomas to which tar was applied, and they took place regularly and with unprecedented rapidity in those receiving methylcholanthrene. Under the influence of this last numerous cancers often arose in a single papillomatous mass, and some had exceeded a centimeter in diameter by the 63rd day after virus inoculation, that is to say, by the 55th day after papillomas had first become visible in the gross. In one instance a metastasis 1.2 cm in diameter was found in a regional lymph node on the 71st day. Sections of it disclosed squamous cell carcinomatosis like that already present at several spots amidst the papillomatous masses treated with tar and methylcholanthrene.

The cancers derived directly from the virus-infected cells, as do those which arise eventually in the ordinary course of events. Any interference which stimulates these cells may hasten malignancy<sup>9</sup>—a fact which holds true of tar papillomas also.<sup>4</sup> The question comes up of whether the chemical carcinogens did not act in this non-specific way in the present experiments; for they induced a more vigorous proliferation than occurred in the control growths. But highly effective non-specific stimulation falls far short of methylcholanthrene in bringing on malignant changes. During several years we have subjected virus papillomas to various stimulative procedures with the aim of procuring cancers as soon as possible, but have never succeeded in reducing the interval between inoculation and cancer to less than 4 months, and usually it has amounted to several months more. The repeated injection under papillomas of Scharlach R in olive oil, a non-carcinogenic mixture as the experience of many workers has shown, results in extraordinarily exuberant proliferation, and the appearance of cancer is often hastened, though not nearly so much as in the present experiments in which stimulation was less pronounced. The tar brought on fewer cancers than did methylcholanthrene, a finding which accords with the known carcinogenic effectiveness of the two agents.<sup>9</sup> These had been applied, not only to the virus papillomas but to the skin of the animals, and here by the end of the tests they had frequently evoked benign tumors of the sorts they usually call forth.

Of the known factors concerned in the production of the cancers the virus was obviously the most responsible and effective. Methylcholanthrene as such, when applied to the skin of domestic rabbits, does not give rise to visible papillomas for nearly two months at least—a fact exemplified in the present animals—and usually they do not appear until much later, while

<sup>1</sup> Work done with the aid of a fund from the Staff of Public School No. 158, Borough of Brooklyn, New York City.

<sup>2</sup> R. E. Shope, *Jour. Exp. Med.*, 58: 607, 1933.

<sup>3</sup> P. Rous and J. W. Beard, *Jour. Exp. Med.*, 60: 701, 723, 741, 1934.

<sup>4</sup> P. Rous and J. G. Kidd, *Jour. Exp. Med.*, 69: 399, 1939.

<sup>5</sup> P. Rous, J. W. Beard and J. G. Kidd, *Jour. Exp. Med.*, 64: 401, 1936.

<sup>6</sup> Green has injected methylcholanthrene under virus papillomas with negative results (H. N. Green, Report of the Yorkshire Council of the British Empire Cancer Campaign, Hunters Armley, Ltd., Leeds, 1940-41, 13).

<sup>7</sup> The methylcholanthrene (Eastman Kodak Company) was dissolved in ether containing 2 per cent. of mineral oil. For some of the tests the tar was diluted with this solvent in a 1 in 10 proportion. It came from the Oostergasfabrik of Amsterdam—a gift from Dr. Karl Landsteiner.

<sup>8</sup> P. Rous and J. G. Kidd, *Jour. Exp. Med.*, 73: 365, 1941.

<sup>9</sup> J. W. Cook, G. A. D. Haslewood, C. L. Hewett, I. Hieger, E. L. Kennaway and W. V. Mayneord, *Am. Jour. Cancer*, 29: 219, 1937.

cancer supervenes only after 9 months to 2 years, and infrequently then.<sup>10</sup> The tar we employed sometimes elicits papillomas after a few weeks, being stimulative as well as oncogenic,<sup>4</sup> but cancer is a very late and rare occurrence. The virus, in contrast, causes papillomas at once, and if nothing further be done and the growths prosper (for some retrogress), they nearly always become cancerous after 6 months to a year. The chemical carcinogens hurried along a process which would have occurred anyhow.

The skin papillomas and cancers of unknown cause which are evoked by tar and benzpyrene undergo singular alterations when they are experimentally infected with the papilloma virus.<sup>11</sup> Most of the papillomas suddenly begin to grow with great rapidity, and many of them alter histologically in ways more or less clearly indicative of the presence of the virus, with result in widely diversified, papillomatous neoplasms. Not a few of the tar papillomas which were previously benign, and which would have disappeared if let alone, change at once to squamous cell carcinomas; and tumors which were of the latter sort at time of infection may suddenly start to grow very fast and undergo cytological changes referable to the virus. Evidently the actuating cause or causes for the tumors evoked by the chemical carcinogens works in concert with the virus to cause these phenomena. The question arises of whether a similar joint action, with the association occurring in reverse order, may not have been responsible for the present findings. The facts give no support to this hypothesis. The application of tar and methylcholanthrene to the virus-infected cells did not result in the highly diversified and rapidly growing papillomatous neoplasms mentioned above, and such cancers as arose wholly resembled those ordinarily developing, in histology and behavior.

It seemed possible that the virus might have exerted so dominating an influence upon the cells with which it was already associated as to obscure the effects of any superimposed neoplastic changes referable to the carcinogens. The changes produced by the latter in the uninfected epidermis of the test rabbits assume importance in this relation; for the response of rabbit skin to the chemical carcinogens, as expressed in growths elicited, varies widely from animal to animal, and the local findings provide an index to the general potentialities of the tissue.

To learn the responsiveness of the skin of our rabbits the carcinogens were applied to areas situated immediately next virus papillomas that were similarly treated, or opposite them on the other side of the belly.

<sup>10</sup> Unpublished personal experience.

<sup>11</sup> P. Rous and J. G. Kidd, *Jour. Exp. Med.*, 67: 399, 1938; *ibid.*, 68: 529, 1938; *ibid.*, 71: 787, 1940; A. Lacassagne and W. Nyka, *Bull. Assn. franc. étude cancer*, 26: 154, 1937; J. McIntosh, *17th Ann. Rep. Brit. Empire Cancer Campaign*, London, 1940, 44.

The range of response proved great, many tar and methylcholanthrene papillomas developing on the skin of some of the animals after relatively brief exposure to the carcinogens, while in other cases none appeared throughout the period of the applications. The happenings in the virus papillomas varied independently of the cutaneous phenomena. Some of the rabbits which had most cancers developing from the virus-infected epidermal cells were nearly or quite free from skin tumors due to tar or methylcholanthrene, whereas the animal in which cancer appeared last of all, and then at one spot only, had skin notably responsive to the chemical carcinogens, numerous papillomas arising early where they were painted on. These results, like the character of the growths arising from the virus papillomas, speak against the possibility that the chemical carcinogens acted by bringing about neoplastic changes additional to those which the virus-infected cells would have undergone in the ordinary course of events.

The influence of many carcinogens, even those of widely differing character (as, *e.g.*, ultraviolet light and methylcholanthrene, beta radiation and benzpyrene), can be combined or summated; and within limits one such agent can often be substituted for another with result in tumors of the usual sorts. Conceivably the malignant alterations in the virus papillomas were due to some such process, the chemical carcinogens and the virus acting in a similar way, and together, to elicit cancers due intrinsically to neither of them. One would have to suppose, though, that the epidermal cells infected with the virus were so altered thereby that those least responsive to the influence of tar and methylcholanthrene under ordinary circumstances were now often markedly susceptible and *vice versa*.

The role of the virus in the carcinogenesis remains to be considered. It impelled the cells to a lively neoplastic proliferation throughout the period while tar and methylcholanthrene were applied to them, and many of the derivative cancers had a histology<sup>4</sup> which indicated its continued morphological influence. The possibility has to be thought upon that the chemical carcinogens acted by influencing the virus, either directly or through induced pathological alterations in the cells which are its milieu and medium of expression. Many facts point to virus variation as the cause for the changes in cell behavior and morphology occurring when cancers arise spontaneously from virus papillomas.<sup>12</sup>

PEYTON ROUS

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<sup>12</sup> J. G. Kidd and P. Rous, *Jour. Exp. Med.*, 71: 489, 1940.

## POLYPHENOLASE ACTIVITY AS A PRIMARY CAUSE IN DARKENING OF BOILED POTATOES<sup>1</sup>

It has recently been reported<sup>2</sup> that a compound (or compounds) reacting like catechol (orthodihydroxy phenol) occurs in potatoes during winter storage in proportions which show general correlation with the degree of blackening after boiling. Following that work we have investigated the activity of the polyphenolase system in tubers covering a wide range of discoloration after cooking. The difference in this function, as between normal and seriously discoloring

potatoes, is much more definite than that found for the catechol reaction. As the polyphenolase system is much more active in the oxidation of catechol than of tyrosine, it appears that compounds of the latter type may not accumulate in proportion to the capacity of the tuber for discoloration. Our results thus indicate that departure from the normal respiratory relations after harvesting is a primary cause in darkening of boiled potatoes. A more extensive account of this work will be published soon.

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## SCIENTIFIC APPARATUS AND LABORATORY METHODS

### A COLORIMETRIC TEST FOR VITAMIN K<sub>1</sub>

DAM *et al.*<sup>1</sup> while working on the isolation of vitamin K discovered that the isolated purified material gave, in the presence of sodium alcoholate, a violet blue color, changing to red and eventually to brown. Subsequently, both vitamins, K<sub>1</sub> and K<sub>2</sub>, were found to give this reaction.<sup>2, 3, 4</sup> As far as it can be ascertained there has been no further report on the development of this test.

Sullivan and Irreverre<sup>5</sup> have shown that 1,4-naphthoquinone-2 potassium sulfonate is a highly specific reagent for creatinine. Since vitamins K<sub>1</sub> and K<sub>2</sub> are derivatives of  $\alpha$ -naphthoquinone it was thought that perhaps there might be a compound in the creatinine group that would give a color reaction with vitamin K, particularly the naturally occurring K<sub>1</sub> and K<sub>2</sub>. No such reaction could be obtained by any of the derivatives of creatinine at our disposal. However, on experimenting with vitamin K<sub>1</sub> and compounds belonging to the carbamic acid series, it was found that vitamin K<sub>1</sub> and 2,3-dimethyl-1,4-naphthoquinone gave a cobalt blue color in the presence of sodium diethyl dithiocarbamate and alkali, or better alcoholic alkali.

The test is performed as follows: To 2 cc of a 95 per cent. alcohol solution of the material to be tested, add 2 cc of 5 per cent. sodium diethyl dithiocarbamate<sup>6</sup> in

95 per cent. alcohol and 1 cc of alcoholic alkali (made by dissolving 2 gm of sodium in 100 cc of 95 per cent. ethyl alcohol). Under this condition vitamin K<sub>1</sub> (0.5 mg per 2 cc) gives a deep cobalt blue color attaining its highest intensity in 5 minutes and fading slowly after 8 minutes. At the end of 30 minutes the color is faintly reddish orange. This reaction was tried on a number of quinones: 2-methyl-1,4-naphthoquinone<sup>7</sup>; 2-chlor-1,4-naphthoquinone; 2-amino-1,4-naphthoquinone; 2-hydroxy-1,4-naphthoquinone; 2,5-dimethyl-1,4-naphthoquinone<sup>8</sup>; 2,6-dimethyl-1,4-naphthoquinone<sup>8</sup>; 2,7-dimethyl-1,4-naphthoquinone<sup>8</sup>; 2,8-dimethyl-1,4-naphthoquinone<sup>8</sup>; 2,6-dimethyl-3-hydroxy-1,4-naphthoquinone<sup>8</sup>; 1,4-naphthoquinone; 2,3-dichlor-1,4-naphthoquinone; 2-methyl-3-hydroxy-1,4-naphthoquinone<sup>7</sup>; 1,2-naphthoquinone; 3-methyl-2,3-oxido-1,4-naphthoquinone<sup>7</sup>; 1,4-naphthoquinone-2,3-oxide. All the compounds enumerated gave a color: pink, red, green, brown or violet. The cobalt blue color, however, was exhibited only by vitamin K<sub>1</sub> and 2,3-dimethyl-1,4-naphthoquinone.<sup>7</sup> It is believed that the cobalt blue color is characteristic of 2,3-dialkyl substituted  $\alpha$ -naphthoquinones in the  $\alpha$ -naphthoquinone series, since the 2,3-dichlor-1,4-naphthoquinone gave a brownish violet color. Vitamin K<sub>2</sub> was not on hand. All the hydroxy derivatives gave red colors. The Dam *et al.*<sup>1</sup> test was also tried on all the substances mentioned, as follows<sup>9</sup>: To 4 cc of a 95 per cent. alcohol solution of the material to be tested, add 1 cc of alcoholic alkali (made by dissolving 2 gm of sodium in 100 cc of 95 per cent. ethyl alcohol). In our hands all the substances tested gave a color: yellow, orange,

from Eastman Kodak Company. If the substance is not pure it should be recrystallized from warm 95% alcohol with decolorization by carboraffin. A 5% solution of the colorless purified material in 95% alcohol should be practically colorless. This reagent must be freshly made and will keep for only a day.

<sup>7</sup> These compounds were furnished through the courtesy of Merck and Co., Inc.

<sup>8</sup> These naphthoquinones were kindly supplied by Dr. Louis F. Fieser.

<sup>9</sup> Dam *et al.* do not give any details for running their test.

<sup>1</sup> Published with the approval of the Director of the Wisconsin Agricultural Experiment Station. Supported in part by grants from the Wisconsin Alumni Research Foundation and done under the auspices of the University of Wisconsin Works Progress Administration Natural Science Research Program.

<sup>2</sup> C. O. Clagett and W. E. Tottingham, *Jour. Agr. Research*, 62: 349, 1941.

<sup>3</sup> H. Dam, A. Geiger, J. Glavind, P. Karrer, W. Karrer, E. Rothschild and H. Salomon, *Helv. Chim. Acta*, 22: 810, 1939.

<sup>4</sup> P. Karrer, *Helv. Chim. Acta*, 22: 1146, 1939.

<sup>5</sup> L. F. Fieser, *Jour. Am. Chem. Soc.*, 61: 2559, 3467, 1939.

<sup>6</sup> A. A. Klose and H. J. Almquist, *Jour. Biol. Chem.*, 132: 469, 1940.

<sup>7</sup> M. X. Sullivan and F. Irreverre, *Jour. Biol. Chem.*, 133: 41, 1939.

<sup>8</sup> The sodium diethyl dithiocarbamate can be obtained

red or green, while vitamin  $K_1$  and 2-amino-1,4-naphthoquinone gave different shades of violet. The Dam *et al.* test was not found to be quantitative.

The sodium diethyl dithiocarbamate test is sensitive to 0.01 mg vitamin  $K_1$  per 2 cc of 95 per cent. alcohol of 5 gamma per cc. With the use of a Klett-Summers photoelectric colorimeter and No. 54 green filter this reaction is practically quantitative for vitamin  $K_1$  in pure solution, from a range of 0.01 mg per 2 cc to 1.0 mg per 2 cc. Since the color is stable only for a few minutes the colorimetric readings must be taken every minute for 10 minutes immediately following the addition of the last reagent. The highest reading is then used. Example: 0.1 mg  $K_1$  gives the highest reading of 60 in 5 minutes, while 0.05 mg reads 30, the highest in 5 minutes. The reading of 30 is just half of 60, while 0.05 is half of 0.1. The stability of the color changes with respect to concentration. At lower concentration the color is more stable than at the higher ones. This reaction of sodium diethyl dithiocarbamate and alcoholic alkali with vitamin  $K_1$  gives a color five-fold that of the Dam *et al.* The use of absolute alcohol as solvent for standards and reagents in both tests has practically no advantage over 95 per cent. ethyl alcohol.

The reaction of vitamin  $K_1$  with sodium diethyl dithiocarbamate and alcoholic alkali is far more sensitive than that of Dam *et al.* and has the additional advantage in that it can be used quantitatively.

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#### CONCENTRATION OF ENZYMES AND OTHER BIOLOGICAL COLLOIDS BY DIALYSIS

It is sometimes desirable to reduce the volume of a tissue extract or biological fluid containing desired enzymes or proteins, yet to avoid the denaturation which occurs more or less during concentration processes such as evaporation by use of mild heat, distillation *in vacuo*, long standing in desiccators with dehydrating agents, etc. By dialyzing against a concentrated solution of dextrin it is usually rather easy and simple to concentrate many such solutions to one tenth to one fiftieth of their volumes. There is no disturbing physical or chemical treatment; the process is relatively rapid, 4 to 18 hours of dialysis is in all probability sufficient for any requirement; and (in some cases the greatest advantage) the dialysis can be done under a low temperature in a refrigerator or cold room. Stirring will, of course, further hasten the process when speed is of very considerable importance, although at room temperature there will usually be no need for this.

The writer has used the process particularly for purifying and concentrating phosphatase extracts from kidneys. The work involved mostly dialysis of 10 or 20 cc only, although larger set-ups can be used, and there seems to be no reason why the process can not be of use on a commercial scale.

Cellophane tubing 1.9 cm in diameter with 0.00183 cm wall (Fisher Scientific Company  $\frac{1}{4}$  inch diameter by 0.00072 inch wall) and about 13 cm in length was used most. If the lower half of a No. 2 rubber stopper is holed to contain a glass tube 1 cm outside diameter by about 5 cm long, the Cellophane may be readily slipped over the stopper and held by means of a rubber band or cord. The lower end of the Cellophane tube becomes completely impermeable when tied close with polished cord. If, however, a cord tie is not wanted in the solution the tubing may be cut twice as long, doubled back, and the cord end tied to the glass tube above the solution. The large inside diameter of the glass tube (about 8 mm) is best because it allows the free introduction of a pipette for adding or removing liquid from the inside of the dialysis tube.

Dialysis is best made against 45-50 per cent. of dextrin in water. Seventy-five per cent. dextrin solution is not difficult to prepare and can be used, but the viscosity is great and there is much precipitation on standing in a refrigerator. When 10 or 20 cc is to be concentrated the writer has found 200 cc 45-50 per cent. dextrin as the "outside solution" to be desirable. In a tall beaker or glass this conveniently submerges the Cellophane tube contents suspended from above and allows diffusion to take place readily.

The properties of dextrin make it very suitable, in fact outstandingly so, for the above process. Other colloids, such as albumin, gelatin, gum ghatti, acacia, starch, agar, pectin, etc., are not suitable.

GUY E. YOUNGBURG

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#### BOOKS RECEIVED

- DEARBORN, WALTER F. and JOHN W. M. ROTHNEY. *Predicting the Child's Development*. Pp. 360. Sci-Art Publishers. \$4.50.  
FORD, CLELLAN S. *Smoke from their Fires; The Life of a Kwakiutl Chief*. Pp. 248. Illustrated. Yale University Press. \$3.00.  
HAYAKAWA, S. I. *Language in Action*. Pp. ix + 245. Harcourt, Brace. \$2.00.  
PORTERFIELD, AUSTIN L. *Creative Factors in Scientific Research*. Pp. xi + 282. Duke University Press. \$3.50.  
*Twelve Months of Health Defense; Activities of the Health Department of the City of New York for 1940 with Comparative Vital Statistics Tables and a Review of Developments since 1934*. Pp. 283. Illustrated. New York City Health Department. \$1.00.  
U. S. Public Health Service. *Bulletin No. 265; Fatigue and Hours of Service of Interstate Truck Drivers*. Pp. xxiii + 286. Illustrated. Superintendent of Documents, Washington, D. C. \$0.40.

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## THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

### PRELIMINARY ANNOUNCEMENT OF THE DALLAS MEETING

Edited by DR. F. R. MOULTON

PERMANENT SECRETARY

FROM next December 29 to January 3, inclusive, the association will hold its one hundred tenth meeting in Dallas, Texas. The Southwestern Division of the association and the Texas Academy of Science are joining with the association to make the meeting a notable scientific event in the Southwest. Fourteen of the fifteen sections of the association and two subsections will present a program, a number of which will be comprehensive symposia on subjects of current scientific importance. At these sessions the chairman of the respective sections will deliver their addresses as retiring vice-presidents of the association. In addition,

thirty affiliated and associated societies and several local Texas societies, besides numerous educational institutions, are joining in the numerous programs that have been organized.

Perhaps the prospects for the meeting in Dallas can be made clear most easily by comparing a few statistics pertaining to it with those of other meetings held in southern cities. Five previous annual meetings have been held in the South: New Orleans, 1905-06; Atlanta, 1913-14; Nashville, 1927; New Orleans, 1931-32; Richmond, 1938-39. In the following table the number of papers that will be presented at Dallas is

an estimate subject to corrections. The data for the membership of the association are as of September 30 of the respective years. The fiscal year of the association ends on September 30.

Year	Meeting Place	Papers Read	Membership
1905	New Orleans	211	4,321
1913	Atlanta	443	8,350
1927	Nashville	1,141	14,862
1931	New Orleans	1,263	19,889
1938	Richmond	1,706	19,059
1941	Dallas	1,500	21,798

It will be noted that the membership of the association decreased by more than 800 during the depression and recession years from 1931 to 1938, but that there has been a substantial increase since that time in spite of the new world war. Although the national defense effort in this country increases daily the disturbance to its normal life and adds to its tax burdens, more than one thousand new members were added to the rolls of the association during the past October, many of whom are distinguished leaders of American science, education and industry. This remarkable increase in membership is an expression of the fact that we owe to science and its applications the amazing physical and cultural advantages of our day, and of the firm conviction that science is by far the most important guarantor of our future.

At present scientists by thousands from hundreds of our educational institutions and industrial laboratories are making contributions to the national defense that admittedly are unparalleled in efficiency and importance. These voluntary contributions are nearly always made at the cost of much personal inconvenience and often with financial loss not only to the scientists but to the institutions with which they are associated. This fine feeling of responsibility to our country and to civilization will often find expression during the meeting at Dallas. In the almost equally dangerous days that will follow immediately after the close of the war, scientists, accustomed to the long view, will be a great stabilizing force until society rides on an even keel again. Since the varied interests of the association extend into nearly every worthy field of human aspirations and endeavor, it has great advantages over every other organization in serving as an integrating agency of scientific forces for effective combined action. The many thousands of members of the association should begin preparations now for making their joint influence an important steadying factor after the close of the war.

#### REGISTRATION

Registration headquarters will be on the mezzanine floor of the Baker Hotel. This hotel and the Hotel Adolphus are both serving as general headquarters for the meeting and are within five blocks of the buildings where two thirds of the general and scientific

sessions of the meeting will be held. The Jefferson Hotel is about eight blocks from registration headquarters and Southern Methodist University is about four and one-half miles distant. A visible directory of all registered persons and their Dallas addresses will be available throughout the meeting at the Baker Hotel.

Each person registering will receive a General Program of the meeting, a book of about 300 pages, which will contain complete information concerning hotel headquarters for all sections and societies, a schedule of dinners and luncheons, announcements of social features, a brief description of the science exhibition, complete scientific programs of all sections and societies, a summary of events scheduled by days, and an index of all persons appearing on the programs. Each person registering will receive also a badge and an identification card which may be required for admission to certain functions. The registration fee is one dollar.

#### HOTELS AND HEADQUARTERS

*General Headquarters:* Hotel Adolphus and Hotel Baker.

Headquarters of the Sections of the Association and of the societies meeting with the Association in Dallas are as follows, the rates quoted being for rooms with bath:

*Adolphus, Commerce, Akard and Main Sts.:* All sections of the Association, American Society of Zoologists, American Society of Parasitologists, American Phytopathological Society, Mycological Society of America, American Society of Naturalists, Genetics Society of America, American Microscopical Society, Society of the Sigma Xi, American Science Teachers Association, Gamma Alpha Graduate Scientific Fraternity, Beta Beta Beta, Honorary Biological Fraternity, American Association of Scientific Workers, the National Social Science Honor Society, Pi Gamma Mu, Inc., Metric Association. Rates: single, \$2.50-\$5; double, \$4-\$7.

*Baker, Commerce and Akard Sts.:* American Association of Physics Teachers, American Meteorological Society, Botanical Society of America, American Society of Plant Physiologists, Sullivant Moss Society, American Fern Society, American Society of Plant Taxonomists, Phi Sigma Society, Potato Association of America, United Chapters of Phi Beta Kappa, Honor Society of Phi Kappa Phi, Sigma Delta Epsilon, Graduate Women's Scientific Fraternity, Texas Academy of Science. Rates: single, \$2.50-\$5; double, \$4-\$7.

*Jefferson, Wood, Jefferson and Houston Sts.:* Limnological Society of America, Ecological Society of America, National Association of Biology Teachers, American Nature Study Society. Rates: single, \$1.50-\$4; double, \$2.50-\$6.

*Southern Methodist University Dormitories:* American Society for Horticultural Science.

# OTHER HOTELS IN DALLAS

*Ambassador*, 1312 S. Arvey St. Rates: single, \$3-\$5; double, \$3.50-\$6.

*Bluebonnet*, 1302 Commerce St. Rates: single, \$1.50-\$3.50; double, \$2.50-\$5.

*Campbell*, Elm and Harwood Sts. Rates: single, \$1-\$2; double, \$1.50-\$3.

*Cliff*, 204 E. Jefferson Ave. Rates: single, \$1-\$1.50; double, \$1.25-\$2.50.

*Dallas Athletic Club*, Athletic Club Building. Rates: single, \$2.50-\$5.

*Maurice*, 909 Main St. Rates: single, \$1-\$1.50; double, \$1.50-\$2.

*Mayfair*, 723 N. St. Paul St. Rates: single, \$1.50-\$2.50; double, \$2.50-\$4.

*McLose*, 3015 Oak Lawn Ave. Rates: single, \$3-\$4; double, \$5-\$7.

*Sanger Apartments*, Ervay and Canton Sts. Rates: single, \$2-\$5; double, \$3-\$7.

*Savoy*, 1908 Commerce St. Rates: single \$1-\$1.50; double, \$1.50-\$2.

*Scott*, Houston and Jackson Sts. Rates: single, \$2-\$5; double, \$3-\$3.50.

*Southland*, Main, Murphy and Commerce Sts. Rates: single, \$1.50-\$3; double, \$3-\$5.

*Texas*, Jackson and Houston Sts. Rates: single, \$1.50-\$2.50; double, \$2.50-\$4.

*Whitmore*, Commerce and Martin Sts. Rates: single, \$2-\$5; double, \$3.50-\$10.

*White-Plaza*, Main and Harwood Sts. Rates: single, \$2-\$3; double, \$2.50-\$6.

# TRANSPORTATION

Although Dallas is considered by many persons to be located in a remote section of the United States, it is only about 1,900 miles from New York City and 1,050 miles from Chicago, and may be reached by trains, planes and buses. The regular round-trip railway and airplane fares to Dallas from representative cities are as follows:

	Railroad fare	Pullman (lower)	Airplane fare
Chicago	\$42.95	\$14.70	\$ 84.32
Cleveland	58.40	18.90	115.92
Denver	36.50	12.60	84.14
Detroit	56.20	17.90	108.18
Kansas City	22.30	9.00	49.50
Minneapolis	44.35	16.80	111.82
New Orleans	23.43	9.00	53.30
New York	74.00	24.70	148.68
Philadelphia	68.75	23.70	140.94
St. Louis	30.05	11.60	61.02
Washington	67.85	21.60	126.80

All fares are subject to the 5 per cent. Federal tax. The railroads will arrange for through cars to Dallas from Chicago, Washington and New York, provided a sufficient number of passengers warrant such an ar-

rangement. Other passengers will change trains in St. Louis.

# EXCURSION TO MEXICO CITY

Those attending the Dallas meeting who are interested in a tour to Mexico City may arrange such an excursion with the Missouri-Kansas-Texas Railroad Company. The tour will occupy thirteen days of travel and sightseeing, the first stop being at San Antonio, Texas. Nine of the remaining days will be devoted to sightseeing and automobile trips in and around Mexico City. There is much of scenic and historic interest in the tour as it is outlined and it offers a splendid opportunity for a brief vacation following the meeting. The cost for one person for all expenses, including railroad fare and Pullman (lower berth), but exclusive of personal items, such as gratuities, wines, mineral water, etc., is \$181.18 from Dallas and return. Or arrangements can be made for the round-trip from the home city with stop-over at Dallas at a saving in fare of about \$3. Full details can be obtained by writing to the office of the railroad at 9 Rockefeller Plaza, New York, N. Y.

# OFFICIAL MEETINGS

*The Executive Committee of the Council* will meet at 4:00 P.M. on Sunday, December 28, in the Permanent Secretary's rooms in the Hotel Adolphus, and thereafter as it shall determine.

*The Council of the Association* will meet at 2:15 P.M. on Monday, December 29, in Parlor E of the Hotel Adolphus, and thereafter as it shall determine.

*The Academy Conference* will be held on Monday, December 29, in Parlor E of the Hotel Adolphus at 3:30 P.M., or immediately after the adjournment of the council. The conference will be followed by a complimentary dinner to one representative of each affiliated academy and to designated representatives of the association. The dinner will begin at 6:30 P.M.

*The Secretaries Conference* will begin with a dinner at 6:30 P.M. on Wednesday, December 31, and will be followed by the discussion program.

# ANNUAL SCIENCE EXHIBITION

The annual science exhibition will be held in the Baker Hotel from 9 A.M. on Monday, December 29, to 6 P.M. on Thursday, January 1. In general, the exhibition will be open at 9 A.M. until 6 P.M., but on Tuesday it will be open until 8 P.M.

# GENERAL SESSIONS

On Monday, December 29, at 8:15 P.M., Dr. Albert F. Blakeslee, director of the Station for Experimental Evolution of the Carnegie Institution of Washington, will deliver his address as retiring president

of the American Association for the Advancement of Science on "Individuality and Science." This session will be held in the Auditorium of the First Baptist Church.

On Tuesday, December 30, at 8:15 p.m., Dr. Edwin P. Hubble, astronomer of the Mount Wilson Observatory of the Carnegie Institution, will deliver the twentieth annual lecture under the joint auspices of Sigma Xi and the association. The title of Dr. Hubble's address is "The Expanding Universe Theory." This session will be held in McFarlin Auditorium on the campus of Southern Methodist University.

On Wednesday, December 31, at 5 p.m., Dr. Rufus B. von KleinSmid, president of the University of Southern California, will deliver the third annual Phi Kappa Phi lecture.

On Wednesday, December 31, at 8:15 p.m., Dean Christian Gauss, of Princeton University, will deliver the seventh annual Phi Beta Kappa lecture in McFarlin Auditorium, Southern Methodist University, on "Can We Educate for Democracy?"

#### ENTERTAINMENT, LUNCHEONS AND DINNERS

The Local Committee will hold a reception for the officers and members of the association and their guests in the Ball Room of the Hotel Adolphus immediately following the address of Dr. Albert F. Blakeslee on Monday evening, December 29.

The American Society of Naturalists, in cooperation with other biological societies and with the association, will hold the Annual Biologists' Smoker at 9:30 p.m. on Tuesday, December 30.

The American Association of Physics Teachers will hold a luncheon on Tuesday, December 30.

Section on Chemistry will hold a dinner on Monday, December 29.

The American Society of Zoologists will hold a dinner on Tuesday, December 30.

The American Society of Parasitologists will hold a luncheon on Tuesday, December 30.

The Botanical Society of America will hold a dinner on Tuesday, December 30.

The American Phytopathological Society will hold a dinner on Tuesday, December 30.

The American Society of Plant Physiologists will hold a dinner on Monday, December 29.

The American Society of Plant Taxonomists will hold a dinner on Monday, December 29.

The Department of Botany of the University of Chicago will hold a luncheon on Wednesday, December 31.

The Genetics Society of America will hold a luncheon on Tuesday, December 30.

The Executive Committee of the American Microscopical Society will hold a luncheon on Monday, December 29.

Beta Beta Beta will hold a luncheon on Wednesday, December 31.

Pi Gamma Mu will hold a luncheon on Wednesday, December 31.

The Metric Association will hold a dinner on Tuesday, December 30.

The American Society for Horticultural Science will hold a dinner on Tuesday, December 30.

The American Science Teachers Association will hold a luncheon on Tuesday, December 30.

The American Nature Study Society will hold a breakfast on Wednesday, December 31.

Phi Kappa Phi will hold a breakfast on Tuesday, December 30.

Gamma Alpha will hold a luncheon on Tuesday, December 30.

Sigma Delta Epsilon will hold a luncheon on Tuesday, December 30, and a breakfast on Wednesday, December 31.

(To be concluded)

## SOCIAL IMPLICATIONS OF VITAMINS<sup>1</sup>

### II

By Dr. ROBERT R. WILLIAMS

CHEMICAL DIRECTOR, THE BELL TELEPHONE LABORATORIES

But what useful lessons can humanity *en masse* draw from contemplation of this perspective of the ages? What guidance does it give him for the conduct of his racial affairs? May I suggest two points: first, that knowledge brings his significant individual physical environment immeasurably more within his command than a generation ago; second, that his inner nature remains a heritage of a very hoary antiquity

<sup>1</sup> Lecture given on the occasion of the fiftieth anniversary celebration of the University of Chicago, September 22, 1941.

which still changes only as the hills change by the slow processes of weathering. With the first, he can adventure with a hopeful intelligence; but the second he must conserve at the peril of extinction.

That man is bringing his external environment increasingly under his control can well be observed throughout the course of history. Cultivated herds and crops, houses, tools, stores of metals, coal and oil, mechanical and electrical power have made his life increasingly secure and leisureful. Almost within our

own memories he has learned of his microbe enemies and has added measurably to his span of life by controlling them. Latest of his discoveries is that his food, which he has continued to choose as the ancients chose it, by its reaction on his palate, contains scores of factors which contribute in unseen but profound and specific ways to his interior environment.

Until about the beginning of this century, there were no generally accepted standards of food requirements. Each judged for himself by his sense of fullness under his belt. When he judged for others, he did so with envy of the luxurious rich or with complacent contempt for the unenterprising poor, according to his own station in society. Women were long recognized by male physicians as being prevailingly anemic. This was thought an appropriate attribute of the weaker vessel till McCance found as late as 1936 that men and women attain the same level of hemoglobin if both receive an abundance of iron. Till recently, food needs were largely a matter of personal prejudice, a characteristic that even nutritionists perhaps have not yet wholly outgrown.

Only within the past decade has the conviction become general that we must do something systematic about our food supply. There were prophets a generation ago who pointed out that the incomes of the poorer half of society were insufficient to provide adequate diets, but their voices carried little weight as their standards of adequacy were unsupported by direct evidence. When long-term nutritional experiments with animals began to be carried out, all manner of unsuspected anomalies appeared very rapidly. No scientist except perhaps Casimir Funk was capable of the necessary credulity to guess how many vitamins there might be. The conservatives began by denying there were any, then gradually and grudgingly admitted the possibility as the long years passed, first of one, then two and so on one by one as a miser parts with his coins. All now concede the existence of a dozen while half as many more are still in the controversial stage.

Most of the earlier animal studies were performed with very much simpler diets than the bulk of humanity consumes. The object of doing so was to keep each article free from significant impurities and thus to ascertain what are the minimum essentials. The method has been amply justified by the discovery of a succession of essential nutrients. The known nutrients in proper proportions now, for the first time, permit a degree of nutrition in the rat which approximates, though it does not equal, the best that can be done with natural food mixtures. We appear to be nearing our goal of a full knowledge of what is essential at least for this one species.

As our knowledge has progressed, several attempts

have been made to test the adequacy of customary human diets for the nutrition of the rat. In many instances relatively poor quality human diets have proven poor for the nutrition of the rat by comparison with very simple mixtures of natural foods, even though the latter are given with unvarying monotony for months or years. As an example, rats fed on a poor-class English diet comprising white bread, margarine, tea with milk, boiled cabbage, boiled potato, canned meat and jam, failed miserably. Growth was stunted, the young were badly proportioned, the coats of all were staring and glossless and by the sixtieth day of the experiment they began to kill and eat the weaker members of the colony. At the end of 190 days, corresponding to about sixteen years of the normal life of man, they were sacrificed. Both pulmonary and gastrointestinal disease was found abundantly present on autopsy. By contrast, rats fed a simple mixture of whole wheat and whole milk grew and reproduced through many generations without evidence of abnormality.

McCarrison, who has done more than any one else to evaluate human diets by experiments with rats, has laid special emphasis on the diets of India, where he did his work. As is well known, the peoples of North India are larger in stature and much more muscular and vigorous than those of the southern end of the Deccan peninsula. Rated according to mean stature and weight, seven important racial elements fall in the following order—Sikh, Pathan, Maharatta, Goorkha, Kanarese, Bengali and Madrassi. Their diets range downward by gradations from that of the Sikh, who subsists chiefly on a coarse wheat flour called "atta," a sprouted bean known as "dhal" and milk, including melted butter or ghee. In the South rice with a little fish or meat makes up the food. Rats fed for two years on these diets showed gradations of vigor comparable with those of the Indian peoples. To take a single example of the incidence of disease, peptic ulcer was found in 29 per cent. of the rats fed on the South Indian diet and not a case in those fed the North Indian ration. Similar contrasts were found by the use of other experimental animals.

Modern studies by Orr in England itself indicate that the diets there present almost as wide a range of nutritional excellence, but one can not as readily reduce them to numerical terms, for the diets have not been submitted as systematically to animal experimentation. By all the evidence adduced by Drummond and Wilbraham in the book "500 Years of the Englishman's Food," this contrast in nutritional quality of food is a product of the industrial age. It did not exist to a like degree one hundred years ago, though inadequacy in quantity was then even more prevalent among the poor.

Increasingly it becomes reasonable to suppose that the falling birth rate which characterizes peoples of long-established cultures may be traceable to dietary causes. Food supply has always been a major motive of human striving. When the supply becomes secure as to quantity, there has always appeared historically a marked tendency to adorn it with elegances of selection or of preparation. Just as simplicity of food characterizes primitive cultures, so epicurean delights of the table have characterized declining civilizations.

Experimentally, we know that food may in some degree determine mentality and disposition. In great measure it determines vigor and efficiency. To some degree it influences resistance to infection and therefore death rates. It may demonstrably determine fertility and influence maternal instinct. The chemical bases of sex urges are already in part known, but the relationship, if any, of their genesis to components of the diet is not yet evident.

Will not continuing examination surely reveal whether, or to what extent, food supply has governed the tides of conquest not only by furnishing a prize of war but also by crowding the populations of the aggressors, intensifying their pugnacity and at the same time reducing the birth rates and undermining the vigor of those destined to be vanquished. This thought has grown in part from the observation that of all the peoples of Western Europe to-day, the Germans have practiced the decortication of grain for human use far the least extensively. They have enjoyed a more generous supply of thiamin and other vitamins which grains provide than Scandinavia, the Low Countries, France, Spain, Italy or the British Isles. Perhaps pacifism is a product of malnutrition. If so, malnutrition has its virtues. I prefer to believe that the pacific spirit is a product of democratic organization and that we can perhaps achieve German efficiency and thoroughness without suffering an attack of belligerency.

To associate efficiency with details of food supply may seem to many a far cry. Yet it seems justified at least in part by a recent experiment at Mayo Clinic under the guidance of Dr. Wilder and his associates involving eleven women of the staff. On a diet low in grain vitamins, they became "depressed, irritable, quarrelsome, uncooperative and fearful. Their ability to work suffered because of inattention, uncertain memory and loss of dexterity." Corresponding physical evidences of impairment were noted. "All of these abnormalities, including the anemia, could be corrected only by raising the level of intake of thiamine." Many other competent observers report an increase of buoyancy of spirits and a greater resistance to fatigue achieved by the regular administration of thiamine to people laboring under what are for them normal nervous strains.

In so far as we can approach any social problem from the view-points of physics, chemistry and physiology, we shall be on far more certain ground, for in these fields observations can be made experimentally and objectively to a degree impossible along the lines of sociological approach. It may well be possible to preserve the vigor of youthful civilization without sacrificing the intellectual and cultural advancement of long stabilized societies. There is no sufficient evidence that the decadence of nations is due directly to a weakening of the germ plasma. Germ plasma is a relatively stable inheritance.

The first attempts at reform of mass nutrition have been inaugurated within recent months. They began with the British decision in July of last year that under the stress of war the staple bread of its people should not continue to be emasculated by refining of the grain till its nutritive quality is demonstrably impaired. Like action in the United States was inaugurated last November, partly under the influence of the British example. In both countries, retention of the natural nutrients of the grain is encouraged, but in order that some prompt mass effect should be achieved the use of synthetic restoration of the nutrients is permitted. This has the effect of preserving the whiteness of the bread, a quality still demanded by popular taste, and so avoids the long postponement of an effective remedy. In America three vitamins, thiamin, nicotinic acid and riboflavin, as well as iron, are required to be added to flour or bread which is artificially "enriched." These are nutrients which naturally occur in grain and are known to be more or less widely lacking in the American dietary. While the precise amounts which are to be added are not yet fixed by official regulation, the contemplated quantities are nearly those present in whole grain bread. The progress of the program has been somewhat more rapid in America than was possible in Britain amid the havoc of war. In our country already we are told that half the family flour and a large fraction of bakery bread are enriched in this manner. Those versed in nutrition will eagerly await the first evidences of its reaction on the public health. Many forecast a major betterment as the practice becomes more universal.

This action has been endorsed after extended study by the Food and Nutrition Committee of the National Research Council under the able chairmanship of Dr. Russell M. Wilder. It is a part of a national program of nutritional benefit including popular education, production and distribution to special groups of superior foods and many other phases. There is no intention to resort to general rectification of the food supply with synthetic nutrients. A very few other staples may be favorably considered for such treatment. A special concern is the amplification of the

vitamin A supply, perhaps through butter and butter substitutes, but no runaway wholesale application of our recently acquired knowledge need be feared.

But if the addition of an artificially-made substance to our food can be justified is there any artificial alteration of man's ways of life that must be condemned as a departure from nature? Can one consistently be a progressive in one field and a conservative in another and if so how can one define the boundaries of either?

The discerning biologist will answer that one should be progressive in matters which are subject to preliminary experiment. Among such are those which make up environment. If a mistake should be made in such a matter, its ill effects will be less permanent and can be corrected when the error is discovered. One must be conservative in what can not be forecast by systematic experiment. The latter includes both physical inheritance of the individual and social organization of a nation or race. Since small-scale experiment is slow, broad social decisions have in general rested only on *a priori* reasoning. This is little more than guessing, in testimony of which please note the diametrically opposite views held with great assurance by different schools in sociology, economics, education, etc.

Our environment has been subject to change throughout the period of evolutionary development and is now grossly different from that of primitive man, but the process of natural selection by survival of the fittest is still, so far as we know, the only means of developing a better race or indeed of preventing retrogression. Our present inheritance is the only base from which we can proceed to select further. We may experiment with our environment, using animals in the early stages, but we can not make a trial alteration of our genes. We can even experiment with our own food after extended and judicious experiment with the foods of animals, but we can not experiment on a wholesale scale with our economic structure or our social organization without affecting a nation's future. Social and economic experiment, so called, is often experiment in name only and bears no practical resemblance to experiment in the physical and biological sciences. The latter deals only with a small sample and does not affect the whole.

As I see the evidences of evolution, especially those derived from genetics and from biochemistry, nature's process is one of timeless patience and inexhaustible ingenuity. What more useful lesson can we learn than that nature does not wantonly discard what it has produced but builds ever by adaptation of its earliest concepts. As best we can discern, nature has preserved many mechanisms ever since the process of evolution first began in the mud eons ago. Among

these mechanisms are not only those chemical mechanisms of which we have spoken but also those of individual variation and selection of the better adapted by eradication of the worse. Nature's mode has been that of trial on a small scale, a scheme which man rediscovered only some two hundred years ago and dubbed the experimental method. From the conscious application of that method in the fields of the physical and biological sciences has grown the entire product of man's modern mastery of nature.

Society is also, by all evidences, an evolutionary product. We note insect societies of great complexity. Presumably they, like ours, developed because they possessed survival value. So our society should further develop along lines which offer the greatest survival values. Even the spiritual nature of man is an evolutionary product, for we see man's spiritual and intellectual qualities in more elemental and primitive but still recognizable forms in many higher animals. These qualities as well as the social integration toward which they impel us appear to have arisen from submission, one by one of the traits produced by individual variation, to the test of compatibility with the environment.

Only the experimental method, so it seems, offers tangible promise of improving our social and economic structure. But, as in its other applications, experiments in social fields must be on a small scale, even at the risk that each experiment shall be poorly controlled. If so, each man must still be free to follow his own discretion, subject to restraint only when he interferes with the like freedom of his fellows. Love of liberty is not a mere catch phrase but a cosmic wisdom growing out of man's racial experience. His social cooperation in an ideal society must grow with his sense of advantage of cooperation and not by compulsion. His leaders, if they are to be worthy of a following, must appeal not to the sense of immediate advantage of an individual or of his group or class but to the desire of each for the preservation of his freedoms. I submit that all despots, autocrats and Fuehrers, as well as advocates of reform by compulsions, share a common arrogance of opinion in the face of the record of man's upward climb almost, if not quite, exclusively by trying this and trying that, first on a small scale. We may well ask each of those who would save us with a slogan whether it is reasonable to suppose that his advent on the scene marks a turning point in the hundreds of thousands of years of social evolution.

The foregoing is of course an over-simplification. Modern societies are so complex that it is extremely difficult to determine just when one man's freedom begins to infringe another's. What has been said is only the expression of a broad principle which nature

appears to have used consistently throughout the drama of expanding life. The principle is, however, worth enunciating, for the main trends of human thought and action about racial affairs during recent times and especially during the past decade seem definitely in a contrary direction. We are indulging in credulity if we accept panaceas for social ills, if we think to remake human society overnight and most of all if we submit to sweeping changes at the behest of captivating leaders.

Such a view will not be accepted without controversy. Few people are evolutionists in social matters. Prejudices are easily aroused in such affairs especially in the discussion of current questions. To escape these prejudices, we shall do well to look at human history by centuries or by eras and not focus our attention wholly on to-day's headlines. Our American economic history has long been one of booms and depressions and, especially since the Civil War, has involved a series of class subsidies; first, land grants to railroads, then tariffs as protection for manufacturing and, latterly, benefits to agriculture and special privilege for labor. To correct our past over-corrections, we have instituted a score of government regulatory bodies to curb whichever of our past sinful creations happens at the moment to be gaining an ascendancy. Many of the evils can be traced to ancient fictions; for example, that a corporation is a person and its members free from individual responsibility or the idea that a labor union if unincorporated can not be sued. Shall we ever reach the end of regulation short of complete tyranny or inaction unless we return to nature's pattern of individual experiment? To escape anarchy we shall have to have laws, but we should strive to limit these to principles which are nearly universally accepted. Respect for even small minorities is part of the essence of democracy. Such is the view of human society best justified by the perspective of evolution.

Ancient civilizations died apparently of ennui. Depopulation, born perhaps of the substitution of artificial luxury for natural simplicity and heterogeneity of population resulting from the import of elements of subjugated peoples, preceded conquest by more virile neighbors. Whatever the complex causes, a high degree of humanism was not one of them. Our civilization does face this added cause of decay. So long as humane feeling concerns itself only with cultivation of a kindlier sympathy between man and man or class and class, it sweetens the whole of life and enriches culture without doing a direct biological injury. We should not be willing to forego our spiritual aspirations even to assure the physical integrity of posterity. Harshness and cruelty, however, never had a highly selective effect anyhow. Child labor,

for example, destroyed good blood as much or more than bad, for it was the industrious and skillful child whose labor was most valued. War and pestilence were also not very discriminating. When, however, humane feeling implements itself with the tools of modern medicine, it does a major biological injury by saving the congenitally unfit. The fit less need its ministrations.

Looking forward then to the decades that shall follow the present cruel and destructive war, biologically intelligent humanity faces first the task of restoring freedom of thought and enterprise, freedom to resume practice of the ancient experimental method. Any other course, no matter how appealing to sentiment or *a priori* reasoning, must only delay the progress of mankind. Artificial restrictions to free interplay must be dispensed with. Trade barriers must be removed between nation and nation. Class legislation which rates men otherwise than according to intrinsic individual worth must be abolished. Artificial subsidies must likewise be set aside. Virtue which can not stand on its own feet in a fair field is dubious virtue; weakness which must forever be protected is ruinous.

Once these principles are popularly accepted perhaps we shall be prepared to begin our second and even more difficult task, to invent means, both scientifically sound and humane, to restore or reenforce the process of natural selection for the protection of the future of the race. We can not dismiss this as wholly utopian and impossible. Artificial selection in the breeding of plants and animals is more efficacious and much faster than natural selection ever was because it leaves much less to chance. But the basic tasks of measuring biological excellence, of devising humane measures of restraint of reproduction of the unfit and of promoting the declining reproduction of the desirable will be as challenging to future genetics, biochemistry and medicine as will the equally necessary job of persuading the masses to accept the measures, to future sociology and law. The latter will be possible only if we of the scientific fraternity supply tangible objective facts for guidance and for proof. This should not appal us. Are we not the sole conscious practitioners of nature's ancient method of small-scale experiment? Science in its own fields now commands a popular respect almost beyond its deserts. Is it not our duty to urge the use of its uniquely useful tool and method in other fields of human endeavor? Shall we grow impatient if an understanding of its method and an extension of its thought to other fields requires repetition? No, for our responsibilities are race-wide and extend beyond the realm of things into the realm of the spirit of man himself.

# OBITUARY

## JAMES TROOP

JAMES TROOP, one of America's earliest teachers of entomology, died at the home of his daughter in Urbana, Illinois, on October 14, at the age of 88 years, just three months after the death of his wife at Lafayette, Indiana, his home for 57 years.

Professor Troop was born on March 14, 1853, at Bennington, New York. He graduated from Michigan Agricultural College in 1878, where he was an associate of such notable scientists as Clarence P. Gillette and Liberty Hyde Bailey. The next year he spent in doing post-graduate work at Cornell University and the winter following in study at Harvard. In 1880 Professor Troop returned to Michigan Agricultural College to become a member of the horticultural staff, and received his master of science degree there in 1882.

Troop came to Purdue University in the fall of 1884, retaining his connection with this institution to the day of his death, more than fifty-seven years. When he came to Purdue as head of the department of horticulture and entomology, there was only one other teacher on the agricultural faculty. In addition to entomology and horticulture, he taught forestry, botany and veterinary science. After 28 years as head of horticulture and entomology, the combined department was divided and Troop took over the headship of the entomology department, which he held until 1920, when he became professor emeritus.

From 1899 to 1907 Troop was state entomologist of Indiana, in which position he had charge of regulatory work, including nursery inspection. From 1896 to 1901 he was secretary of the Indiana Horticultural Society, of which he was president in 1933.

Because Professor Troop was a pioneer in the field of horticulture and to a large degree responsible for the development of this industry in Indiana, he was affectionately known as the "Grand Old Man of Indiana Horticulture." Many of the achievements in this field in Indiana may be attributed to his foresightedness and pioneer work.

As a teacher Troop was outstanding, as evidenced by the facts remembered and fond recollections expressed by his many former students.

Aside from his official duties with Purdue University, Professor Troop was active for many years in university and community affairs. He was a charter member of the Purdue Chapters of Alpha Zeta, and Acacia fraternity. He was past commander of the Lafayette Commandery of Knights Templars, of which he was also prelate for thirty-three years. He was active in church circles, being superintendent of the Baptist Church Sunday School and deacon of the same church for many years.

Professor Troop is survived by a daughter Helen, wife of Professor O. H. Sears, of the University of Illinois, and two grandchildren, Marjorie and Gordon Sears.

J. J. DAVIS

PURDUE UNIVERSITY

## NORMAN JACKSON HARRAR

January 7, 1902–October 16, 1941

ON October 16, 1941, Dr. Norman Jackson Harrar, chairman of the Chemistry Department of Franklin College, at Franklin College, died of pneumonia. Sulpho-compounds and blood transfusions offered by his students failed to bring about recovery, probably because of his poor health of several years standing.

Harrar was born in Philadelphia, Pennsylvania, on January 7, 1902, and had his early education in that state. Completing his undergraduate studies, he was awarded the B.S. degree with a major in chemistry at the University of Pittsburgh in 1922. Shortly thereafter he went to Colorado and from 1924 to 1927 served as an instructor in chemistry at the Colorado State College in Fort Collins. The year 1927–28, he served as an assistant in chemistry at Pennsylvania State College and was awarded the M.S. degree. Returning West that fall, he served as an assistant in chemistry at the University of Colorado until 1930, at which time he was awarded the Ph.D. degree. During the following two years he was an assistant professor of chemistry at Washington and Lee University at Lexington, Virginia; since 1932 he has served as professor and head of the chemistry department at Franklin College. In 1935 he was chairman of the Indiana Section of the American Chemical Society and in 1937 was chosen as a councilor representing the Indiana Section in the national organization. Following the lead of professional chemists in Pennsylvania, the executive committee of the Indiana Section studied the need of an incorporated organization of the chemists of the state. As a result of this study, the "Indiana Chemical Society" was incorporated in 1939 and Harrar was chosen as its first president. As stated in the constitution, the purpose of the society is "to encourage in the broadest and most liberal manner the advancement of chemistry as a science and as a profession in the state of Indiana, especially in fostering public welfare and education in matters involving chemistry in all its branches and its applications, aiding the development of industry and promoting the health, happiness, and prosperity of the people of the State of Indiana."

Although Dr. Harrar's principal interests were centered in his teaching, he, nevertheless, kept up an

active interest in research, having published a number of papers on the iron cycle in nature dealing with the effect of humic acids on the naturally occurring oxides of iron. He was also interested in studies dealing with salt craving in animals and in arsenic tolerance. Historical studies in the field of chemistry were of most immediate interest to him as evidenced by the publication of a historical paper on "Sulfur from Popocatepetl," and an unfinished manuscript on the history of chemistry. He was a member of the chemical professional society of Alpha Chi Sigma and of Sigma Xi. At the time of his death, he was serving as the coach of the college golf team.

Dr. Harrar is survived by his wife and two sons by a former marriage. In his death science has lost a man of rare ability and a charming personality.

FRANK E. E. GERMANN

UNIVERSITY OF COLORADO

## RECENT DEATHS

DR. WALTHER NERNST, formerly professor of physical chemistry and director of the Physico-Chemical Institute of the University of Berlin, Nobel laureate in 1920, died on November 18 at the age of seventy-seven years.

DR. KURT KOFFKA, William Allan Neilson professor of experimental psychology at Smith College, previously from 1911 to 1918 professor of psychology at the University of Giessen, died on November 21. He was fifty-five years old.

MAJOR EDWIN CLARENCE ECKEL, since 1933 chief geologist of the Tennessee Valley Authority, died on November 22 at the age of sixty-seven years.

DR. MAX KRISS, associate professor of animal nutrition at the Pennsylvania State College, with which he had been associated since 1918, died on November 16 at the age of fifty-two years.

## SCIENTIFIC EVENTS

### THE THAILAND DEPARTMENT OF SCIENCE

THE ninth biennial report of the Thailand Department of Science, which is summarized in the *Journal of the Council for Scientific and Industrial Research of the Commonwealth of Australia*, describes a great increase in the activities of the department. One form of expansion is the addition of a Division of Pharmacy to the Divisions of Chemistry, Agricultural Science and Industrial Chemistry, already in existence. The new division will undertake research into indigenous drugs and the manufacture of certain galenical preparations, and it will examine and standardize drugs and biological preparations imported into, or manufactured in, Thailand. The division is housed in a modern two-storied building containing offices, balance rooms and six laboratories.

The Division of Industrial Chemistry, formerly known as the Division of Technology, was exclusively devoted to the manufacture of Vitamin B<sub>1</sub> extract and drugs for the treatment of leprosy; the Vitamin B<sub>1</sub> extract is obtained from rice bran, and 1,600 litres of it were prepared during the two years under review. A Ceramics Section has now been incorporated in this division, and the workshop attached to the division has been considerably enlarged so that it is able to construct much of the apparatus previously imported or manufactured outside the department. The Division of Agricultural Science is largely engaged on soil surveys and analyses, but it also analyzed various foods and animal fodders, and investigated the fertilizing values of bat and swallow guano. The Division of Chemistry carries out large numbers

of routine assays of opium dross submitted by the Excise and Opium Department, and of bronze for coinage, submitted by the Treasury Department. It also has a Water Analysis Section which is growing in magnitude each year as water works are being started in most of the important towns of the kingdom.

The production of solar salt and the production and utilization of soya beans are two important problems that have been investigated by committees set up by the Department of Science. Analyses of Thai soya beans show that their nutritional value is comparable to the Manchurian species.

During 1936-38, six officers of the department were sent abroad to gain experience, principally in the fields of pharmaceutical chemistry, spectrography, ceramics and petroleum refining.

### GRANTS MADE TO THE UNIVERSITY OF ILLINOIS

FOURTEEN grants were made to the University of Illinois during April and May, ranging from \$300 to \$6,250, and amounting in all to \$21,170. They are as follows:

John and Mary R. Markle Foundation, New York City, \$6,250 to support Dr. Ernst Gellhorn's investigation of the physiological foundations of convulsions and of the treatment of dementia praecox, in the College of Medicine.

Nutrition Research Laboratories, Chicago, \$3,900 to continue the research program being carried on in the department of physiology in the College of Medicine under the supervision of Dr. C. I. Reed.

Parke, Davis and Company, \$2,000 for research on renal hypertension.

Allied Chemical and Dye Corporation, New York City, \$1,500 for the establishment of two fellowships of \$750 each, to be awarded to outstanding graduate students in organic chemistry and to be known as Allied Chemical and Dye Corporation Fellowships.

Standard Brands, Inc., of New York, \$1,450 for the renewal of their grant under the title of "Yeast Effect on the Digestive Tract," carried on in the department of physiological chemistry, College of Medicine.

American Dry Milk Institute, \$950 for research on calcium in foods.

Tennessee Coal, Iron and Railroad Co., \$1,450 for research on steel brake shoes.

The New York Community Trust, on behalf of an anonymous client, \$960 to pay the stipend of a graduate fellowship in chemistry during the academic year 1941-42. This is a continuation of a fellowship awarded during the last academic year.

The Velsicol Corporation, Chicago, \$760 for the support of the researches on insecticides conducted by Dr. Clyde W. Kearns, of the department of entomology.

Niagara Sprayer and Chemical Company, Inc., Middleport, N. Y., \$500 for a proposed project on the testing of lead arsenates.

The American Dry Milk Institute, Inc., Chicago, \$500 for research work in the department of animal husbandry for biological tests on "enriched bread."

The American Medical Association, \$350 for a study of water soluble proteins by Dr. William H. Welker, of the College of Medicine.

A. E. Staley Manufacturing Company, Decatur, \$300 for the purpose of carrying on a study of "Sweetose" as used in various dairy products, to be carried on by the department of dairy husbandry.

The Kelco Company, San Diego, California, \$300 to cover a study on factors that alter calcium utilization.

Vaughan's Seed Store, Chicago, \$300 for a study of the synergistic action of certain organic sulfur compounds when used in an agricultural insecticide.

#### FELLOWSHIPS IN CHEMISTRY OF THE E. I. DU PONT DE NEMOURS AND COMPANY

E. I. DU PONT DE NEMOURS AND COMPANY have announced the award of six post-doctorate fellowships and twenty-two post-graduate fellowships for research in chemistry for the academic year 1942-43.

A post-graduate fellowship in chemical engineering, as well as one in chemistry, will be awarded this year at the Massachusetts Institute of Technology. The University of North Carolina joins the list of those granted post-graduate awards. Twenty-one institutions in all will benefit. Post-doctorate fellowships are for \$2,000 each, and post-graduate fellowships are for \$750 each.

The post-doctorate fellowships will be placed under

the direction of R. T. Arnold, instructor, University of Minnesota; Paul Bartlett, assistant professor, Harvard University; Ralph Connor, assistant professor, University of Pennsylvania; R. C. Elderfield, assistant professor, Columbia University; C. B. Purves, assistant professor, the Massachusetts Institute of Technology, and H. R. Snyder, instructor, University of Illinois. Appointments to the post-graduate fellowships will be made later in the academic year by the heads of the departments of chemistry of the respective universities.

The twenty-one institutions to which post-graduate awards have been granted are the University of California, University of Chicago, Columbia University, Cornell University, Harvard University, University of Illinois, the Johns Hopkins University, the Massachusetts Institute of Technology, the University of Michigan, the University of Minnesota, the University of North Carolina, Northwestern University, the Ohio State University, Pennsylvania State College, the University of Pennsylvania, Princeton University, Purdue University, Stanford University, University of Virginia, University of Wisconsin and Yale University.

Fellowships for advanced work in chemistry were established by the du Pont Company in 1912, when there was a dearth of men adequately trained for chemical research. Through the fellowship plan, the company sought to prepare promising young men for a career in this phase of science. These grants, which with one interruption have been maintained since 1918, differ from the average industrial fellowship in that the selection of the beneficiary and the subject of research is left to the discretion of the university. There is no actual or implied obligation as to future employment of the fellowship holder.

#### THE COMMITTEE ON THE PROFESSIONAL TRAINING OF CHEMISTS

THE Committee on the Professional Training of Chemists of the American Chemical Society, of which Professor W. Albert Noyes, Jr., of the University of Rochester, is chairman, has issued a report on progress in which it is said that ten colleges and universities have been added to the list of educational institutions whose work in chemistry has been approved. The total number of accredited schools is now a hundred and two.

A number of institutions have not yet been given formal consideration. For still others action has been deferred, either because the committee wishes to obtain further information or because of pending changes which may alter situations within certain institutions. There has been no intention of specifying the exact content of any course, but merely of

making certain that the student is broadly educated and adequately trained in chemistry.

It is stated in the report that

The committee recognizes that one of the most important factors in assessing the quality of work in an institution is concerned with the personnel of the staff. It is felt that the staff should be adequately trained and properly qualified to teach chemistry. Institutions which meet merely formal requirements without at the same time having the proper personnel can scarcely be considered to do high quality work.

The committee realizes that many institutions have a very high type of instruction in the elementary chemistry courses, but either through lack of funds or insufficient size of staff, are unable to give the advanced work necessary or are unable to give it adequately for the professional training of chemists.

The committee feels strongly that this type of institution serves a very useful purpose in the American scheme of education and that it would be unwise for such institutions to attempt professional training in the sense that the committee uses that phrase. Graduate schools and employers of chemists will continue to recognize that high quality men soundly trained in the elementary principles of chemistry may be obtained from these institutions, and it should be understood that no stigma is attached to their omission from the list of institutions the committee deems to be qualified for the professional training of chemists.

Institutions will be notified as soon as possible after an unfavorable decision has been reached. These institutions may, upon request, receive from the secretary of the committee a statement of the reasons for such unfavorable action. The institutions on the list will be reviewed from time to time and their fitness to retain recognition will be examined. Any institution for which an unfavorable action has been given may, after an interval of two years following the date of notification of such action, request a review of its situation.

Students who receive the bachelor's degree from accredited institutions become eligible for membership in the American Chemical Society following graduation and two years' experience in the field of chemistry or chemical engineering or in post-graduate study. Students who graduate in chemistry or chemical engineering from other colleges will be eligible only after five years.

The ten institutions added to the accredited list are: Bucknell University; Oklahoma Agricultural and Mechanical College, Stillwater; State College of Washington, Pullman; the Universities of Arizona, Buffalo, Denver, Nevada, Pittsburgh and Vermont, and Williams College.

The Polytechnic Institute of Brooklyn has been accredited for instruction in chemical engineering, following approval by the American Institute of Chem-

ical Engineers. The society has now approved the chemical engineering curricula of forty institutions.

#### THE INTERNATIONAL CROP IMPROVEMENT ASSOCIATION

THE twenty-third annual meeting of the International Crop Improvement Association will be held at the Morrison Hotel, Chicago, on December 2 and 3. Dr. E. P. Humbert will preside on the morning of December 2 at a symposium to be introduced by a paper on "A National Policy on Plant Disease Control," by Dr. C. R. Orton, of the West Virginia Agricultural Experiment Station. "The Effect of Seed-borne Diseases on Germination" will be discussed by Dr. W. S. Crozier, of the New York Experiment Station, and problems of seed-borne diseases of particular crops will be reviewed by Dr. R. W. Goss, of the Nebraska Experiment Station, for the Irish potato; Dr. Koehler, of the Illinois Experiment Station, for small grains and corn, and Dr. W. N. Ezekiel, of the Texas Experiment Station, for cotton.

The afternoon session will open with a discussion of "Methods of Applying Seed-borne Disease Control Measures," to be led by Dr. M. A. McCall. "The Determination of Wheat Varieties by Kernel Characteristics and Its Commercial Use" will be presented by F. T. Dines, and O. S. Fisher will give "Progress Report on Certifying Agencies" also during the afternoon session.

The annual banquet will include the address by President A. L. Clapp, an address by R. L. Throckmorton on "Seed Certification—A National Asset," and movies on "Seed Certification in Nebraska" will be shown by E. F. Frolik. The program concludes with a business meeting and committee reports on December 3.

#### MEETINGS ON TROPICAL MEDICINE AT ST. LOUIS

THE thirty-seventh annual meeting of the American Society of Tropical Medicine was held conjointly with the Southern Medical Association in St. Louis, Mo., from November 10 to 13. Special features of this meeting included the Sixth Charles Franklin Craig Lecture on Tropical Medicine given by Dr. K. F. Meyer, of the George Williams Hooper Foundation, San Francisco, entitled "The Known and the Unknown in Plague"; and, as already reported in *SCIENCE*, the first Bailey K. Ashford Award in Tropical Medicine was awarded to Dr. Lloyd E. Rozeboom, of the School of Hygiene and Public Health of the Johns Hopkins University. Dr. Thomas T. Mackie, of New York, delivered his presidential address on "Observations on the Early History of Tropical Medicine" at the annual luncheon of the society. A joint session with the National Malaria Society was held.

The officers elected include:

*President*, Dr. Ernest Carroll Faust, New Orleans, La.

*President-elect*, Dr. N. Paul Hudson, Columbus, Ohio.

*Vice-president*, Dr. Joseph S. D'Antoni, New Orleans, La.

*Editor*, Colonel Charles F. Craig, San Antonio, Texas.

*Secretary-Treasurer*, Dr. E. Harold Hinman, Wilson Dam, Ala.

*Councillors* (for 4 years), Dr. Andrew J. Warren, New York, N. Y.; Colonel James S. Simmons, Washington, D. C.

*Member of Editorial Board*, Dr. Justin Andrews, Atlanta, Ga. (for 5 years).

In conjunction with the Society of Tropical Medicine and the Southern Medical Association the eighth annual meeting of the American Academy of Tropical Medicine was held on November 12. At the dinner

session Dr. Marshall A. Barber delivered the annual presidential address on "The Human Side of Malaria Research." Dr. W. W. Cort presented the Theobald Smith Gold Medal of the George Washington University to Admiral E. R. Stitt, M. C., U. S. N., retired.

Dr. Marshall C. Balfour, International Health Division, Rockefeller Foundation, and Dr. Rolla E. Dyer, chief of the Division of Infectious Diseases, the National Institute of Health, were elected to membership. Dr. C. C. Bass and Dr. L. O. Howard were elected emeritus members. The following officers and a five-year councillor were elected for the year 1942:

*President*, Dr. H. C. Clark.

*Vice-president*, Dr. L. W. Hackett.

*Treasurer*, Dr. T. T. Mackie.

*Secretary*, Dr. E. C. Faust.

*Councilor*, Dr. A. C. Chandler.

## SCIENTIFIC NOTES AND NEWS

THE autumn general meeting of the American Philosophical Society, Philadelphia, was held on November 21 and 22. The evening lecture, entitled "Military Aspects of the Arctic," was given by Dr. Vilhjalmur Stefansson, the Arctic explorer.

THE Mead Johnson Awards for 1941 were announced at the annual meeting in Boston of the American Academy of Pediatrics. Dr. René J. Dubos, of the Rockefeller Institute for Medical Research, received the first award of \$500 for his work leading to the development of gramicidin, used for the treatment of disease caused by pathogenic bacteria, and Dr. Albert B. Sabin, associate professor of pediatrics in the College of Medicine of the University of Cincinnati, received the second award of \$300 for research on diseases of the nervous system caused by viruses.

VICE-PRESIDENT HENRY A. WALLACE will be decorated by the president of Cuba with the order of Carlos J. Finlay on December 3, during his visit to Cuba to attend meetings during which the Finlay Institute of the Americas will be inaugurated.

THE *Journal* of the American Medical Association reports that Dr. Rudolph Matas, professor of general and clinical surgery, emeritus, of the School of Medicine of the Tulane University of Louisiana, was presented on October 25 with *The Times-Picayune* Loving Cup for 1940 "in recognition of his years of unselfish service to his fellowman."

A DINNER in honor of Dr. Joseph C. Beck, professor emeritus of otolaryngology of the College of Medicine of the University of Illinois, was given on September 26. Dr. Beck was presented with a statue of himself which recently won a prize at the exhibit

of the American Physicians Art Association in Cleveland. The statue is the work of Dr. Adolph M. Brown.

EDWARD WESP, JR., a senior in the College of Engineering of New York University, has been awarded the Daniel W. Mead Prize—a certificate and \$50—of the American Society of Civil Engineers in recognition of his paper entitled "Ethics of the Engineer Inspector." The presentation will be made at the annual meeting of the society in January. The contestants included students in a hundred and twenty colleges throughout the country.

AT the annual dinner sponsored by the Chemical Control Committee of the National Fertilizer Association which was given on the evening of October 27, F. B. Carpenter, chief chemist of the Virginia-Carolina Chemical Corporation, presented a silver water piteher and tray to E. W. Magruder, chief chemist of the F. S. Royster Guano Company, who originated the check fertilizer series in 1922.

DR. GEORGE R. MINOT, professor of medicine at the Harvard Medical School, has been elected president of the International Medical Assembly and president of the Inter-State Postgraduate Medical Association of America.

DR. EUGENE McAULIFFE, of Omaha, Nebr., has been elected president of the American Institute of Mining and Metallurgical Engineers. He will take office in February at the annual meeting of the institute in New York.

DR. OREN A. OLIVER, of Nashville, Tenn., was elected president, and Dr. J. Ben Robinson, of Baltimore,

was made president-elect, of the American Dental Association at the Houston meeting.

*Museum News* reports that E. A. Gallup, of Ann Arbor, Mich., was elected president of the American Institute of Park Executives at the New Orleans meeting in October; Donald Wyman, Arnold Arboretum, was elected a director for three years. Officers for the American Association of Zoological Parks and Aquariums elected at the same time are as follows: Freeman M. Shelly, Philadelphia Zoological Garden, *chairman*; John T. Millen, Detroit Zoological Garden, *vice-chairman*; Tod Raper, Columbus *Dispatch*, *secretary*; Mrs. Belle J. Benchley, San Diego Zoological Society, and W. R. Sprott, Little Rock Zoo, *directors*. All officers for the American Association of Botanical Gardens and Arboretums were reelected.

PROFESSOR ALFRED H. WHITE, of the University of Michigan, president of the Society for the Promotion of Engineering Education, has resigned as chairman of the Michigan department of chemical and metallurgical engineering. He is succeeded as head of the department by Professor George E. Brown.

DR. PIERRE AUGER, professor of physics in the Ecole Normale Supérieure of the University of Paris, who is known for his work on cosmic rays, has been appointed research associate in physics at the University of Chicago. Dr. Auger conducted his laboratory in Paris for more than a year after the German occupation. He left the city on October 3 on official leave from the Vichy Government. He plans to accompany an expedition for cosmic-ray study which next summer will visit the research station on the summit of Mt. Evans in Colorado.

DR. CHARLES W. HUNTLEY has been appointed dean of Adelbert College, Western Reserve University. Dr. Huntley has been instructor in psychology at Mather College, Western Reserve University; he will now hold the rank of assistant professor of psychology in Adelbert College and will continue to teach psychology in both colleges.

DR. J. W. TREVAN, director of the Wellcome Physiological Research Laboratories, London, has been elected a director of the Wellcome Foundation, Ltd.

DR. JOHN SUNDWALL, director of the Division of Hygiene and Public Health of the University of Michigan, has been given leave of absence for the second semester.

DR. JOHN EVERETT GORDON, Charles Wilder professor of medicine and epidemiology of the Harvard Medical School, director of the American Red Cross Harvard Hospital Unit in southwestern England, arrived in New York on November 10 on the Atlantic Clipper, for a vacation and to recruit American staff

members for the unit. He expects to return to England in about a month.

SEÑOR MARCELINO A. CERIALE, director of the national standardizing body of Argentina, will visit the United States in February or March as a guest of the American Standards Association. The purpose of the trip is to further friendly relations between the United States and Argentina by giving him an opportunity to study at first hand the development of American industrial practices and standards. After his stay in Washington, he will visit manufacturing centers in Philadelphia, Detroit, Chicago, Schenectady, etc. Steps have been taken to found a South American Committee for Technical Standards, with the purpose of stimulating the organization of national standardizing bodies and ultimately of having an influence on international trade. This committee held its first meeting last month in Rio de Janeiro.

DR. PETER DEBYE, chairman of the department of chemistry of Cornell University, will speak on "The Magnetic Approach to the Absolute Zero of Temperature" on December 3 at a joint meeting of the Franklin Institute with the Physics Club and Physics Colloquium of Philadelphia.

DR. GEORGE H. WHIPPLE, dean and professor of pathology of the School of Medicine and Dentistry of the University of Rochester, delivered on November 28 the sixteenth Pasteur Lecture of the Institute of Medicine of Chicago at a joint meeting with the Illinois Section of the Society for Experimental Biology and Medicine. His subject was "The Production, Utilization and Interrelation of Blood Proteins—Hemoglobin and Plasma Proteins."

ON account of war conditions, Dr. Elmer V. McCollum, professor of biochemistry at the School of Hygiene and Public Health of the Johns Hopkins University, will deliver at the University of Toronto on December 1, 2 and 3 the Harben Lectures of the Royal Institute of Public Health and Hygiene. His general subject will be "Nutritional Science and Public Health."

DR. R. RUGGLES GATES, of the University of London, lectured at Vassar College on November 12 on "Heredity and Environment in Human Genetics" and at Dartmouth College on November 13 on "Human Genetics and Race."

BEGINNING on November 5 and ending on January 21 a series of lectures on tropical medicine will be presented at the School of Tropical Medicine, San Juan, Puerto Rico, by various members of the department of medicine. The lectures will be given by Drs. Ramon M. Suarez, head of the department, by

Dr. R. Rodriguez-Mollina and by Dr. F. Hernandez Morales.

A COMPREHENSIVE survey of employment, unemployment and related labor conditions is being conducted in St. Paul, Minn., by the Employment Stabilization Research Institute of the University of Minnesota, of which Dean R. A. Stevens is director. The present study is jointly directed by Professor Dale Yoder, of the School of Business Administration, and Professor Donald G. Paterson, of the department of psychology. Professor R. L. Kozelka is assisting as consulting statistician. The work is being financed by a grant of \$50,450 from the Rockefeller Foundation.

THE twenty-eighth Congress of Americanists will be held in Santiago, Chile, in March.

A MEETING of the northern California section of the Institute of Food Technologists will be held on December 4 under the presidency of B. E. Lesley, of

California Packing Corporation. Dr. T. L. Swenson, director of the Albany Regional Research Laboratory of the U. S. Department of Agriculture, will preside at the dinner, and Dr. J. Murray Luck, of Stanford University, will speak on Great Britain's food supply.

THE twenty-sixth annual dinner and meeting of the Institute of Medicine of Chicago will be held at the Stevens Hotel on December 2. The presidential address will be delivered by Dr. Rollin T. Woodyatt on "The Story of Acidosis."

THE Southern District meeting of the American Institute of Electrical Engineers will be held at New Orleans from December 3 to 5.

THE next meeting of the trustees of the Elizabeth Thompson Science Fund will be held in April, 1942. Previous awards from the fund were reported in SCIENCE on May 16, 1941, and earlier. Applications for grants should be made to the secretary, Dr. Jeffries Wyman, Jr., Biological Laboratories, Harvard University, Cambridge, Mass.

## DISCUSSION

### UNRECOGNIZED ARID HAWAIIAN SOIL EROSION

WATER is the most important product of the forests of Oahu island, and forage is the most important product from the large areas of non-forested and non-agricultural lands of this and other Hawaiian islands. The continued production of these resources is intimately dependent on soil for absorption and percolation of the precipitation. Absorbed water is necessary for the continuance of plant growth *in situ*. Water percolated through the lava beds maintains the supply that is obtained from an elaborate system of tunnels and wells, and which is used for agricultural and urban purposes. Water neither absorbed nor percolated is largely surface runoff, which feeds the streams and generally flows to the sea, unused by man. The retention of the high rainfall for the production of forage and of usable water is therefore seen to depend on the maintenance and preservation of the soil mantle. Soil erosion is thus a critical factor in the economy and production of a country which is becoming increasingly important to the welfare of continental United States.

The United States may justly boast that it is the first nation in history to recognize incipient stages of soil erosion and to institute elaborate and effective management methods for the perpetuation of the soil mantle under active land uses.<sup>1, 2</sup> The United States furthermore is largely responsible for the recognition

in northern Africa and southwestern Asia of the direful results of unchecked soil erosion and the poverty of land stripped to bed-rock and without the mediating influence of developed soil and vegetation.

Americans, however, need not have gone to other flags to find lands in which erosion had proceeded unchecked, and where, with no more soil to erode, a new equilibrium has been attained as stricken as areas in Africa and Asia known to the author. Since N. E. Winters<sup>3</sup> states that "The problem of soil erosion is not so wide-spread and serious in Hawaii as it is on the mainland of the United States," he is obviously referring to areas in which erosion is now actively occurring and which locally may be as striking as that of our southeastern Piedmont.

Adjacent to these eroding lands in Hawaii and in areas of lower precipitation and lower elevation is a zone, admittedly often narrow on Oahu but widespread on other islands, where soil no longer remains and where the annual increment of rock weathering is not retained by the stable sparse vegetation, but is removed by surface runoff. The theory that these lower arid slopes once bore heavy soil mantles capable of supporting a more luxuriant vegetation than that now existing depends on five lines of evidence: (1) the existence of several relict soil mats, stable on the surface, but eroding rapidly at the margins by undercutting; (2) a stage of rapid alluviation in many valleys which in some cases has buried still living trees to their crowns; (3) the development of narrow

<sup>1</sup> H. H. Bennett, *Science Supplement*, 94: 2429, 8, 1941.

<sup>2</sup> W. C. Lowdermilk, *loc. cit.*

<sup>3</sup> N. E. Winters, *Hawaii Territorial Planning Board Progress Report*, 81-82, 1939.

coastal plains known to have been built by recent sedimentation from the hills; (4) the existence of indigenous floristic elements which could develop a more mesic soil-holding vegetation; (5) the inability of such species to maintain a vegetation in the face of grazing and fire.

Reparation of a region in which soil erosion has been carried to its ultimate conclusion may demand the application of methods quite different from those where it is desired merely to reduce accelerated erosion to normal erosion. Present techniques of reforestation in this zone have not been successful and an intimate knowledge of the requirements of soil-binding species and of a complex plant succession are necessary. The problem commands the ingenuity of conservationists, and upon it hinges the greatly increased productiveness of large acreages in a country where productiveness is becoming more critical.

This consideration of soil erosion in arid Hawaii is based upon field investigations on Oahu during 1936-37 while the author was research fellow of Yale University and the Bishop Museum (Honolulu). The interpretation has been strengthened by subsequent work of the author in this and other countries. The vegetational aspects of the problem are being discussed in a manuscript now in preparation.

FRANK E. EGLER

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#### CONCERNING GASTROPODS ADHERING TO FOREIGN OBJECTS

IN the discussion of *Potadoma agglutinans*, a melaniid snail from the Congo Estuary which cements itself to rocks, we stated that we knew of no other comparable case among fresh-water Gastropoda.<sup>1</sup> In a recent conversation, Dr. Teng-Chien Yen called our attention to the small Chinese "enigmatic shells" described by E. Lamy as *Helicostoa sinensis*.<sup>2</sup> It is interesting to compare this mollusk with our *P. agglutinans*. The flattened, disk-like snail of *H. sinensis* adheres by one of its faces to the free surface of immersed rocks, apparently soon after hatching. At first it is normally coiled, but the spiral eventually spreads out and becomes irregular, much as in certain species of the marine genus *Vermetus*. The mode of adherence is therefore different from that of *Potadoma agglutinans*, which remains turreted, although much deformed, and adheres only where it presses against foreign objects as growth progresses. The smaller, young snails of *Helicostoa* appear to be of two types and the largest, presumably adult snails, reach 10 to 12 mm in diameter. Lamy recognized that *Helicostoa* was operculated, but did not attempt to place it in any

of the known families. More recently, Mrs. A. Pruvot-Fol described the operculum, tentacles and radula from the original material.<sup>3</sup> She proposed for *Helicostoa* a special family Helicostoidae, of the *Prosobranchiata taenioglossa*. She also suggested that the two forms of the young snails were the two sexes, the tentacles and radula being present only in one of them, presumably the male. It would seem to us that the soft parts and radula of *Helicostoa* agree sufficiently with those of either Valvatidae or Bulimidae (Hydrobiidae), the radula being insufficiently known to decide between the two. It is unfortunate that the precise habitat and ecology of this snail are unknown. It was described from specimens attached to a limestone rock labeled merely "Kouei-Tcheou," a city on the upper Yangtse Kiang, more than 1,200 kilometers from Shanghai. It may be surmised that the rock was immersed in swiftly running water, either on the banks of the Yangtse Kiang itself or in the rapids of one of its smaller affluents. The present note is written for the purpose of interesting Chinese naturalists in this remarkable snail. Moreover, a thorough investigation of its habitat may well lead to the discovery of other equally interesting types of rheophilous mollusks, similar to those known from the swift waters of the Congo Estuary.

J. BEQUAERT

W. J. CLENCH

MUSEUM OF COMPARATIVE ZOOLOGY,  
CAMBRIDGE, MASS.

#### ANOPHELES MACULIPENNIS MEIGEN AND ANOPHELES PUNCTIPENNIS SAY FROM NORTH DAKOTA

Two species of malaria-carrying mosquitoes have been found in North Dakota. Specimens of *Anopheles maculipennis* were taken by the authors in fairly large numbers under a concrete bridge over a swampy marsh near Grand Forks on September 20, 1941. Additional specimens of *Anopheles maculipennis* and three specimens of *Anopheles punctipennis* were collected from the ceilings and walls of outhouses in a park near Hillsboro on the same day. The presence of these mosquitoes in the state is not surprising in view of the fact that these species are known to occur in Manitoba and the states surrounding North Dakota.

H. S. TELFORD

CLIFFORD WESTER

NORTH DAKOTA AGRICULTURAL  
EXPERIMENT STATION

#### COLLEGES AND THE CHANGING HIGH SCHOOLS

THE article entitled "Colleges and the Changing High Schools," by M. H. Trytten, under "Discussion"

<sup>3</sup> Bull. Soc. Zool. France, 62: 250-257, 1937.

<sup>1</sup> Bull. Mus. Comp. Zool., 88: 3, 1941.

<sup>2</sup> Jour. de Conchyl., 70: 51-56, 1926.

in the issue of *SCIENCE* of October 24, 1941, quotes me so inaccurately.

It is stated (page 389) with a footnote reference to the *New York Times*, "Dr. S. R. Powers . . . describes the results of a five-year survey. . . ." I have never at any time written for this newspaper. The description referred to was done by a staff reporter of the newspaper and printed under the reporter's name. The statements that "conventional treatment of science will go by the board" and about "scrambled courses," although attributed to me in the newspaper article, were not made by me and do not represent my views even approximately. In general the statements are meaningless when subjected to scrutiny and are irrelevant to the work that is being done under my direction.

The work in progress is carried on under an organization known as the Bureau of Educational Research in Science, of Teachers College, Columbia University, with cooperation of well-trained critically minded high-school teachers and with advice and assistance from scientific men with impeccable reputations as teachers and research workers. Further information about the work of the bureau may be had from the *Teachers College Record*, January, 1939; *Report of the Dean of Teachers College*, 1940; *General Education Board Annual Report*, 1939 and 1940; and from the bureau's publications obtainable through the Bureau of Publications, Teachers College, Columbia University.

S. R. POWERS

TEACHERS COLLEGE,  
COLUMBIA UNIVERSITY

# THE COMPARATIVE COST OF LOAN SERVICE AND OF MICROFILM COPYING IN LIBRARIES

In a discussion<sup>1</sup> of "The Place of Microfilm Copying in Library Organization," the view was expressed that this method of rendering library service might be organized in a manner that would permit its operation at no greater cost than that of lending books. An opportunity to examine this question more carefully has since been obtained and the expectation has been confirmed that the actual cost of these two methods of rendering library service is not very different.

In regard to the cost of making microfilms an analysis<sup>2</sup> of the operation of Medicoilm Service showed that in groups of 100 orders the total expenditure for materials and work at the wage rate of \$1.00 per hour was \$17.25 or 17½ cents per microfilm. This included the time required to obtain the books from the shelves and to replace them after use, as well as that devoted to verifying the film copies and mailing them out, but did not include the time re-

quired for keeping the accounts and collecting for the work done.

Although the extent and practice in regard to lending books varies greatly in different libraries, the experience in the Army Medical Library of Washington is probably typical of many of the larger reference libraries. In this library one employee, devoting her entire time to this work, keeps the records of all books which go out on loan. Others obtain them from the shelves and replace them when returned. Furthermore, the wrapping and mailing is attended to by a library messenger. During the last five years the following number of books have been loaned annually:

Year	Number loaned
1936	12,919
1937	13,886
1938	14,104
1939	13,128
1940	14,000

Average, 13,607

Of these, about 20 per cent. go to local governmental institutions and are called for by messengers and the remainder are sent and returned by mail for which the postage is prepaid by the borrower.

The working schedule in governmental departments is 44 hours per week, which with deductions for holidays and annual leave corresponds to 2,068 hours per year. On the basis of wages at \$1.00 per hour, the actual cost per book loaned is  $\$2,068 \div 13,607 = \$.15$ . If to this is added the 3 cents which is the cost of obtaining each book used for microfilming and replacing it on the shelf as well as the cost of wrapping supplies and messenger service for 80 per cent. of the books loaned, the total cost is appreciably higher than that of making and sending out microfilm copies.

There are, of course, advantages and disadvantages in both of these methods of rendering library service. From the standpoint of the borrower it is evident that those who have not yet become accustomed to using microfilms will object to receiving one in lieu of the loan of the book itself. Others, however, will appreciate the advantage of being able to keep the microfilm copy. From the standpoint of library operation there is little doubt that microfilm service has outstanding advantages in permitting the collections to remain intact for their more uninterrupted use as well as reducing wear and tear of the books.

The evidence here presented shows that libraries could substitute free microfilm service to the same extent that free lending service is now rendered without increasing the cost of operation. If the demand for microfilms increased sufficiently to tax the funds available for this purpose, a very small charge for the microfilms would probably be sufficient to keep expenses within the allotments for this feature of

<sup>1</sup> Seidell, *SCIENCE*, 94: 114-5, August 1, 1941.

<sup>2</sup> Seidell, *Jour. Documentary Reproduction*, 4: No. 3, September, 1941.

library service. In this manner it would be possible for many reference libraries to extend the scope of their usefulness far beyond their present limits. Lastly, the lessened cost of rebinding books due to wear and tear in transit through the mails, represents

a factor of great importance in estimating savings made by the wide use of the microfilm.

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## QUOTATIONS

### PROBLEMS CONFRONTING MEDICAL INVESTIGATORS

IN a recent address at the fiftieth anniversary celebration of Stanford University, Dr. Walter B. Cannon<sup>1</sup> presented some questions which deserve careful study. The shift in age grouping of the population, with increasing percentages of the elderly and the aged, now widely recognized as a fact, has presented the medical profession with a series of new problems. As one grows older, Cannon points out, the fires of life burn less vigorously and the adjustments of bodily organs to emergencies tend to be impaired—the breath is shorter, the heart beats less effectively, blood pressure gradually rises as the years pass and becomes ill adapted to critical requirements. Are these features essential attributes of the elderly or are they the consequences of comfortable and habitual indolence? In middle age some of these effects may result from inactivity alone and can be reversed by training; is this true in the later decades? If so, should attempts be made to alter them? What, Cannon says, would be the effects if they were altered? These questions offer possibilities for useful research. Almost none of the most prominent disorders of senescence are thoroughly understood. The prevailing ignorance, it may be assumed, is largely due to lack of systematic study. The challenge presented by realization of this fact will doubtless receive many answers. Severe demands on the nervous system, which may have arisen in part from the remarkable shift in the occupation of the citizens, often result in calls for medical attention. A disorder of the brain may fail to be revealed at necropsy or under the microscope. And yet emotional upsets which leave in the nervous pathways no visible trace have concrete and obvious effects and may be the occasion for profound misery and suffering. The gradual on-

set of disabilities, bodily and mental, in the later years of life demands, Cannon believes, long-range studies on the possible influence of inheritance, early injuries, severe infections in childhood and youth, frustrated plans, the demands of labor and probably many other conditioning experiences. Cannon also calls attention to the disastrous cooperation of disease, pain and early death when warring hosts or nations battle against nations for supremacy. International developments unquestionably have affected medical research in a warping of scientific activities away from untrammelled pursuits toward problems of military significance. Medical investigators, however, by learning the nature and cure of malnutrition, by devising appropriate treatment for shock and hemorrhage and in many other ways have served to mitigate the torments and ravages of warfare. One of the results of the present war already has been a more intimate association of a highly desirable nature with medical investigators in Latin American nations. Finally Cannon emphasizes as one of the biggest problems facing medical investigators the filling of their own ranks. This is indeed primary, and, unless well-equipped recruits can be attracted to the career of the investigator, progress will end. Cannon dwells at some length on the attractions and rewards of medical investigators, pointing out particularly one consideration eminently creditable to their efforts: "Because life and health are precious and medical research is deeply concerned with protecting life and health, the triumphs of that research are put to use without regard to any national or racial difference. . . . Even though the beneficiaries may despise their benefactors, they must receive the benefactions. . . . The conquest of a disease, it should be remembered, is a permanent conquest."—*The Journal of the American Medical Association*.

## SCIENTIFIC BOOKS

### THE LABORATORY MOUSE

*Biology of the Laboratory Mouse.* By the STAFF of the Roscoe B. Jackson Memorial Laboratory, with a chapter on Infectious Diseases of Mice by

J. H. DINGLE, Harvard Medical School. Philadelphia: Blakiston Company. 1941.

THIS book is the joint work of the staff of the Roscoe B. Jackson Laboratory, under the editorship of G. D. Snell. Some chapters are short monographs on subjects in the investigations of which the Jackson Laboratory has prominently participated, while other

<sup>1</sup> W. B. Cannon, "Problems Confronting Medical Investigators," *SCIENCE*, 94: 171-179, August 22, 1941.

chapters are written more in a text-book-like fashion, summarizing wider fields of the literature. But even in the latter, investigations of the various authors were added to the study of the literature, as, for instance, in the chapter on the early embryology of the mouse by Snell, but also in the chapters on reproduction by Snell, on histology by Elizabeth Fekete, and on spontaneous neoplasms in mice by A. M. Cloudman. There are valuable contributions on parasites by W. E. Heston, and on infectious diseases in mice by J. H. Dingle. Throughout, the illustrations of these chapters are numerous and excellent. To all investigators who work with the mouse, this part of the book will be very helpful; the chapter on the histology of this species will be especially helpful, because the general text-books on histology do not as a rule contain the information needed by the student of this particular species.

The remaining chapters are short monographs dealing largely with work from the Jackson Laboratory. They concern investigations about which there might be differences of opinion. The chapter on gene and chromosome mutations by Snell will prove very useful for geneticists. The chapter on endocrine secretion and tumor formation by G. W. Woolley is a very good summary of our knowledge in this field, although the presentation is rather condensed. One might wish also that the chapter on the milk influence on tumor formation, written by J. J. Bittner, who discovered this interesting condition, might have been somewhat more detailed. It treats of a new, virus-like substance, which is of considerable importance in the etiology of the mammary gland carcinoma in mice, and which is present in the milk and certain organs of mice belonging to strains in which the incidence of this type of cancer is high. It is designated as the "extrachromosomal factor" in order to distinguish it from genetic factors which also have a part in the development of tumors.

The chapters on the genetics of spontaneous tumor formation and on the genetics of tumor transplantation, written by Little, are valuable summaries of the many interesting investigations of Little and his collaborators, in which they used closely inbred strains of mice; and by making this material accessible to other investigators, they have aided cancer research in many other laboratories. As might be expected, some of the views expressed in these chapters are controversial. To mention only some of these points: It is doubtful whether there exists an absolute distinction between these closely inbred strains and the strains used by earlier investigators, a number of which were also, to some degree, inbred. There are only quantitative differences between these various types of strains, and notwithstanding the larger number of variable factors with which the earlier investi-

gators had to contend, they were able to establish some of the principal facts concerning the hereditary conditions underlying the origin as well as the transplantability of cancer. As early as 1912 it was suggested that the results obtained in the transplantation of tumors could be explained on the basis of Mendelian rules, by assuming the presence of multiple factors in the sense in which Nilsson-Ehle and other geneticists had used this term. However, even to-day no definite knowledge exists concerning the mode of hereditary transmission of the genetic factors active in the origin of mammary gland carcinoma of the mouse.

As to the criticism which Little has raised against the theory of the individuality differential, the justification for this criticism may be questioned; it might be held that the success or lack of success of tumor transplantations which Little has used in the analysis of individuality is not suited for this purpose. A successful transplantation of cancerous tissue is a threshold phenomenon and differs from the results in transplantations of normal tissues, which represent graded series of reactions of the host, which can be shown to correspond to the graded character of the individuality differentials in various organisms. The transplantations of normal spleen which Little and Bittner carried out in a few experiments were not controlled by microscopic examination. Furthermore, it is doubtful whether the method used for the determination of the number of factors on which the transplantability of tumors is supposed to depend furnishes valid results. The importance of such determinations may also be doubted, because the number of factors found would vary with each different combination of tumor and host. There are also serious objections to the conclusion that somatic mutations in tumors play the significant role in the transplantability and also in the origin of tumors which is attributed to this factor by Little and his collaborators.

The chapter on inbred and hybrid animals and their value in research (W. L. Russell) is a very instructive and clearly written presentation of somewhat intricate genetic problems. The term "specificity of tissues" is here, as well as in other chapters, substituted for the term "individuality differential." It is not certain that this change is advantageous. The specificity of tissues comprises several conditions, only one of which can be correlated with the individuality differential. The short chapter on the care and recording of mice colonies written by Bittner contains some very good advice for those who are interested in the breeding of these animals for scientific purposes.

Altogether, this is an excellent book, and by writing it the staff of the Jackson Laboratory has made an-

other distinctive contribution. It will be very helpful to investigators in the fields of genetics, tumors, endocrinology, as well as pathology and biology in general.

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### MATHEMATICS

*University Mathematical Texts.* General editors, Alexander C. Aitken, D.Sc., F.R.S., Daniel Rutherford, Dr. Math. Edinburgh and London: Oliver and Boyd. New York: Interscience. *Determinants and Matrices*, by A. C. AITKEN; *Statistical Mathematics*, by A. C. AITKEN; *Waves*, by C. A. COTLSON; *Integration*, by R. P. GILLESPIE; *Integration of Ordinary Differential Equations*, by E. L. INCE; *Functions of a Complex Variable*, by E. G. PHILLIPS; *Vector Methods*, by D. E. RUTHERFORD; *Theory of Equations*, by H. W. TURNBULL. Each volume, \$1.50.

IN continental Europe the publishing of brief introductory texts at a low price has long been an established custom. It is very fortunate that, by constructive editorial activity, the present mathematical series in the English language was started. All the little books of the series published so far can be characterized as unassuming, straightforward, directed toward tangible facts rather than toward generalities, conscious of applications, and written by competent authors. They can not possibly give more than introductory information and they can not suffice as bases for more detailed studies. But within the limitations imposed by their small size (about 65,000 words on the average), they will serve a really useful purpose. It is to be hoped that the editors will be able to maintain the same standards in the future publications of the series.

*A Treatise on Advanced Calculus.* By PHILIP FRANKLIN, Ph.D., professor of mathematics, Massachusetts Institute of Technology. xiv + 595 pages. New York: John Wiley and Sons. 1940.

RIGOR, whatever this word may mean, was one of the great mathematical achievements of the nineteenth century. Only gradually has this tendency penetrated into text-books. The first great work of this kind, Jordan's "Cours d'analyse," was followed by many others, of which Hardy's "Pure Mathematics" seems to be the foremost in English. Franklin's book is an admirable attempt on a much broader scale to combine rigor with completeness in a volume of modest size. It will appeal to readers who are already well informed but want to revise and to supplement their knowledge in the light of modern precision. Not only are the traditional subjects of a book on advanced calculus covered, but also many more advanced topics are included. There is a section on the Laplace transformation, one on Poisson's sum formula, and a brief exposition of the theory of partial differential equations of the first order. The material is presented in an original way with extraordinary care.

Of course it is impossible to discuss analysis from the real number system to the Hamilton-Jacobi theory in less than 600 pages without being somewhat dogmatic. The reader who wants to absorb new material will miss a convincing illumination of motives and goal for all these deductions. The critic may take exception to points where the personal taste of the author has asserted itself in a striking way, such as in the discussion of the trigonometric functions. Or he might be disappointed to find in such a thoughtfully precise book an introductory remark on limits, where the idea of a steadily moving independent variable is mentioned without being explicitly disavowed. From Zeno to Leibniz this concept has been one of the main impediments to rigorous mathematical treatment, and its replacement by "static" concepts was the decisive step towards logical clarity in the modern definitions of limit and continuity. Of course such criticism of minor details does not matter much in view of the merits of the book as a reliable guide. The great effort embodied in this work will certainly assure it a more than transitory place in the literature and a lasting influence on those for whom it is written.

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## SPECIAL ARTICLES

### THE EFFECT OF SULFANYLGUANIDINE ON THE THYROID OF THE RAT<sup>1</sup>

FOLLOWING the announcement of Marshall *et al.*<sup>2</sup> that orally administered sulfaguanidine (sulfanylyl-

<sup>1</sup> Supported by a grant from The Rockefeller Foundation.

<sup>2</sup> E. K. Marshall, Jr., A. C. Bratton, H. J. White and S. T. Litchfield, Jr., *Bull. Johns Hopkins Hosp.*, 67: 163, 1940.

guanidine) reduces the concentration of coliform bacteria in the feces of mice, we investigated the possibility that this substance, when fed to rats on a purified diet containing synthetic B vitamins, would prevent the synthesis of additional essential nutrients by the intestinal flora. In view of Woods's<sup>3</sup> finding that p-amino benzoic acid interferes with the bacteriostatic

<sup>3</sup> D. D. Woods, *Brit. Jour. Exp. Path.*, 31: 74, 1940.

action of sulfanilamide, its effect on rats fed diets containing sulfaguanidine was explored. The action of yeast was also tested. At the time of the completion of this work, Black *et al.*<sup>4</sup> reported that liver extract, and to a lesser degree p-amino benzoic acid, prevented the growth-inhibiting effect of sulfaguanidine in rats fed a purified ration. Our results on growth are in general agreement with theirs.

We wish to report the extensive alterations observed in the thyroids of rats fed sulfaguanidine<sup>5</sup> in a diet containing synthetic B vitamins<sup>6</sup> and p-amino benzoic acid, or in a diet containing yeast.

The basal ration was composed of purified casein 200, sucrose 600, lard 40, salts 60, 2-methyl-1.4-napthoquinone 0.005, and 13 drops of haliver oil fortified with viosterol. To this mixture was added either 100 parts of dried yeast, or 5 mg each of thiamin, riboflavin and pyridoxin, 15 mg of calcium pantothenate, 250 mg of choline, and 500 mg of cystine, with or without 2.5 gm of p-amino benzoic acid. When added, sulfaguanidine was incorporated at a 1 or 2 per cent. level. The distilled drinking water contained 20 mg of iodine and 40 mg of potassium iodide per liter one day a week.

Rats from our stock colony were placed on these diets at 21 to 23 days of age. Animals receiving sulfaguanidine were sacrificed at periods varying from 6 to 16 weeks. Without exception their thyroids were hypertrophied and hyperemic. The glands were 3 to 8 times larger than those of the control animals receiving the same diets without sulfaguanidine. Rats on the diets containing synthetic B vitamins (without p-amino benzoic acid) plus sulfaguanidine developed bleeding from the anterior corner of the eye, which later involved the whole eye. This symptom was prevented by p-amino-benzoic acid in rats receiving 1 per cent. of sulfaguanidine, but not in those receiving 2 per cent. It was always prevented by yeast.

A second experiment was conducted in which rats on the yeast diet plus 1 or 2 per cent. of sulfaguanidine were killed at the end of 4 weeks and their thyroids removed for sectioning. The glands were hyperemic and 3 to 4 times larger than those of the control animals on the yeast diet without sulfaguanidine. Histologically, the thyroids of the 2 per cent. sulfaguanidine rats showed marked hyperplasia. The epithelium was distinctly columnar, and in most follicles so increased and invaginated as to nearly extinguish the lumen. But few of the lumina contained colloid, and where present it was vacuolated and

shredded. The connective tissue was not appreciably increased, but the glands were very vascular. In the rats receiving 1 per cent. sulfaguanidine, the thyroids contained a little more colloid; and the columnar epithelium was not so invaginated, otherwise the picture was the same. The thyroids of the control rats were normal. They contained an abundance of colloid and the epithelium was of the cuboidal type. Histological examination of the kidneys of these sulfaguanidine animals revealed no abnormalities. The bladders and ureters contained no visible calculi. The growth of the rats on both levels of the drug equaled that of the controls during the 4-week experimental period, and no gross symptoms were observed. (After the fourth week there is a retardation in the rate of growth.) It is of interest to note that Richter and Campbell<sup>7</sup> have very recently reported similar thyroid changes in rats fed phenylthiocarbamide.

At present we are investigating the effect of increasing the iodine intake at the beginning of the experiment and after the thyroid has hypertrophied. We are also testing the action of other "sulfa" drugs, sulfanilic acid, guanidine and thiourea on the thyroid in several species. The results of these studies together with a detailed account of the above observations will be published elsewhere in the near future.

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#### EFFECT OF ULTRAVIOLET LIGHT ON POLYCYCLIC HYDROCARBONS IN STEROL SURFACE FILM SYSTEMS

IN the course of a detailed study of the interaction of carcinogenic and other polycyclic hydrocarbons with sterols and other cellular constituents in mixed films at the air-water interface,<sup>1</sup> the conditions under which such hydrocarbons undergo ultraviolet decomposition have been investigated. Since these experiments may have some bearing on (a) the mechanism of detoxification and disposal of hydrocarbons subject to carcinogenic experiments,<sup>2</sup> and (b) the intense photodynamic effects exhibited by polycyclic hydrocarbons on bacteria<sup>3</sup> and other cells,<sup>4</sup> a preliminary statement of the results is presented here.

In such mixed films with sterols, certain polycyclic

<sup>1</sup> C. P. Richter and K. H. Campbell, *Arch. Path.* (in press).

<sup>2</sup> W. W. Davis, M. E. Krahle and G. H. A. Clowes, *Jour. Am. Chem. Soc.*, 62: 3080, 1940.

<sup>3</sup> L. Velluz, *Compt. rend. Acad. Sci.*, 206: 1514, 1938.

<sup>4</sup> A. Hollaender, P. A. Cole and F. S. Brackett, *Am. Jour. Cancer*, 37: 265, 1939.

<sup>5</sup> I. Doniach and J. C. Mottram, *Nature*, 163: 748, 1940.

<sup>4</sup> S. Black, J. M. McKibbin and C. A. Elvehjem, *Proc. Soc. Exp. Biol. and Med.*, 47: 308, 1941.

<sup>5</sup> We are indebted to Lederle Laboratories, Inc., for the sulfaguanidine used in this experiment.

<sup>6</sup> We are indebted to Merek and Company, Inc., for supplies of the synthetic vitamins.

hydrocarbons can be held in two-dimensional solution or in two-dimensional molecular association with the sterols.<sup>1</sup> By application of pressure to the mixed films, the hydrocarbon molecules can be displaced from their area-determining positions in the film, passing into an excess phase outside of the film, but in close proximity to it. The formation of the excess phase is characterized by the appearance of light-scattering particles which display Brownian movement; when the pressure is released, those hydrocarbons which are capable of solution type interaction with sterols can rapidly re-enter the films with the complete disappearance of the excess phase.

The present experiments show that, when in this excess phase, certain hydrocarbons are extremely sensitive to ultraviolet photodecomposition; on the other hand, when held between sterol molecules in the area-determining film phase, the same hydrocarbons are not subject to photodecomposition at the intensity of ultraviolet light employed.

A 15-watt G. E. germicidal lamp, supplied with an aluminum reflector, was mounted over the previously described<sup>1</sup> film tray at a vertical distance of 8 inches from the surface. The predominant radiation was at 2,537 Å., but the principal mercury emission lines up to 4,338 Å. were also prominent. The mixed films were put under pressures which gave the desired proportion of the hydrocarbon in the excess phase, irradiated for 15 minutes, and the force-area characteristics of the resulting film were then studied.

Typical results with 10-amy-1,2-benzanthracene in mixed films with cholestanol may be cited as a convenient example. This hydrocarbon, when in the excess phase, was converted by irradiation into a surface active substance which was adsorbed, in addition to the sterol, at the water surface; this surface active substance could be detected and characterized by its surface film behavior. The conversion of the hydrocarbon was partially blocked by inclusion of a reducing agent, such as pyrogallol, in the water upon which the mixed film was originally spread; this indicated that the excess phase was in the water beneath the film and that the photodecomposition of the hydrocarbon took place there. This point of view was supported by two other observations: (1) when an aqueous suspension of 10-amy-1,2-benzanthracene was introduced into the water phase immediately under a sterol film, the hydrocarbon molecules entered the film in much the same manner as hydrocarbons enter the film from the excess phase; (2) when an aqueous suspension of 10-amy-1,2-benzanthracene was irradiated in bulk in the presence of dissolved oxygen, the substance formed had exactly the same surface properties as the material produced by irradiation of the 10-amy-1,2-benzanthracene in the excess phase of the mixed films.

Similar experiments were performed with a number of other polycyclic hydrocarbons, including 9,10-dimethyl-1,2-benzanthracene, numerous mono-alkyl-1,2-benzanthracenes, and several mono- and di-alkyl-chrysenes. In each case where photodecomposition occurred in the film experiments, irradiation of the same hydrocarbon in bulk suspension caused loss of its characteristic ultraviolet absorption at wavelengths greater than 2500 Å.

The photodecomposition product isolated after irradiation of the bulk aqueous suspension of 9,10-dimethyl-1,2-benzanthracene corresponded, in its analysis for C and H and in its lack of the characteristic absorption spectra of 1,2-benzanthracene derivatives, to the photo-oxide produced from 9,10-dimethyl-1,2-benzanthracene in CS<sub>2</sub> solution according to the method of Cook and Martin.<sup>5</sup> The relative ease of photodecomposition of the hydrocarbons in the excess phase and in bulk aqueous suspension was found to be the same as the relative photooxidizability in CS<sub>2</sub> as observed by Cook and Martin.

In contrast to the parent hydrocarbons, the photo-oxidation products of 10-amy-1,2-benzanthracene and other alkyl-1,2-benzanthracenes were found to exhibit no interaction with sterols in surface films. The photo-oxides which were prepared from carcinogenic hydrocarbons by Cook and Martin<sup>5</sup> were found by them to be non-carcinogenic.

#### SUMMARY

Certain alkyl-1,2-benzanthracenes and other polycyclic hydrocarbons, when irradiated either in bulk aqueous suspensions or in the comparable excess phase under mixed surface films, were converted rapidly by ultraviolet light to photo-oxides. When held in two-dimensional solution or molecular association with sterols in mixed surface films at the air-water interface, the hydrocarbons were protected from such photodecomposition. In the one case where the comparison could be made photo-oxidation was accompanied by a loss of the ability of the hydrocarbon to interact with sterol films.

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#### A PHYTOPATHOGENIC BACTERIUM FATAL TO LABORATORY ANIMALS

*Phytomonas polycolor* (Clara) Bergey *et al.*, the causal agent of a bacterial leafspot disease of tobacco, was first isolated and described by Clara<sup>1</sup> in the

<sup>5</sup> J. W. Cook and R. H. Martin, *Jour. Chem. Soc.*, 1940, 1125.

<sup>1</sup> F. M. Clara, *Phytopath.*, 20: 691, 1930.

Philippines. The damage resulting from the disease to both seedling and field plants caused great concern in several tobacco-growing areas. Spraying and needle puncture inoculations recently conducted in this laboratory have shown the culture to be pathogenic for tobacco. On the basis of its disease-producing ability in plants, this organism has been placed by systematists among the phytopathogenic bacteria.

In the course of a serological study of the green fluorescent group of phytopathogenic bacteria, to which *Phytomonas polycolor* has been ascribed, it was found that this organism was extremely virulent when introduced into small laboratory animals. Rabbits, guinea pigs and mice were found to be susceptible. Intraperitoneal injections of 0.05 cc of a 24-hour broth culture proved fatal to mice in 12 hours, while 0.25 cc killed 300 g guinea pigs in the same period of time. The intravenous injection of 0.2 cc of a bacillary suspension brought about the death of 2,000 g rabbits in 24 hours. Bacterial cells which had been washed free of metabolites were found to be as lethal as were the broth cultures. In each case the organism was recovered in pure culture from the heart's blood, spleen, liver and lung. Intravenous injections into mice of 0.2 cc of the sterile filtrate of a broth culture failed to kill, whereas the same culture unfiltered was fatal. Varying amounts of washed bacterial cells which had been killed by heating at 55° C for 1 hour failed in each instance to kill mice. Sterile filtrates of

lysed suspensions of the organism (lysed by alternate freezing and thawing) were apparently toxic for mice on intraperitoneal and intravenous injection but failed to cause the death of the animals. It was possible to isolate the organism from the blood stream in moderate quantities 5 or 6 hours before death, and in great numbers just previous to death. There seems no doubt, therefore, that this organism multiplies within the animal and manifests itself in a true bacteraemic fashion. That the organism is not particularly invasive is evident from the fact that very small doses were not fatal. Forced feeding of the organism produced no ill effects. Fifteen other organisms of the green fluorescent group of plant pathogens failed to produce any of the results noted above.

Although a comparative study has not yet been completed, all available evidence points to the probability of this organism being *Pseudomonas aeruginosa*, (Schroeter) Migula. Whatever its true identity, the ability to multiply in both animal and plant tissues is remarkable. The fact that both animals and plants are susceptible to experimental infection makes this organism interesting from an evolutionary point of view.

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## SCIENTIFIC APPARATUS AND LABORATORY METHODS

### A SCALE FOR GRAPHICALLY DETERMINING THE SLOPES OF DOSE-RESPONSE CURVES

THE following device, which may have been overlooked by other workers in the field of biological assay, has been found useful in our laboratories for the routine estimation of the slopes of such dose-response curves as may be transformed into straight lines. It is based on the well-known fact that the slope is a tangent. As Fig. 1 shows

$$b = \frac{y_2 - y_1}{x_2 - x_1} = R \tan \theta \text{ or } \tan \theta = b/R.$$

In these equations  $b$  is the slope,  $x_2$ ,  $y_2$  and  $x_1$ ,  $y_1$  are the coordinates of any two points on the line,  $\theta$  is the indicated angle and  $R$  is the ratio of the length of one plotted unit of dose to the length of one plotted unit of response. The dose-response curve must be plotted in such a way as to give a straight line. This usually can be done for the graded response type of data by plotting response against the log dose. And the curve for the all-or-none type of data may be made straight by converting the response into probits by means of

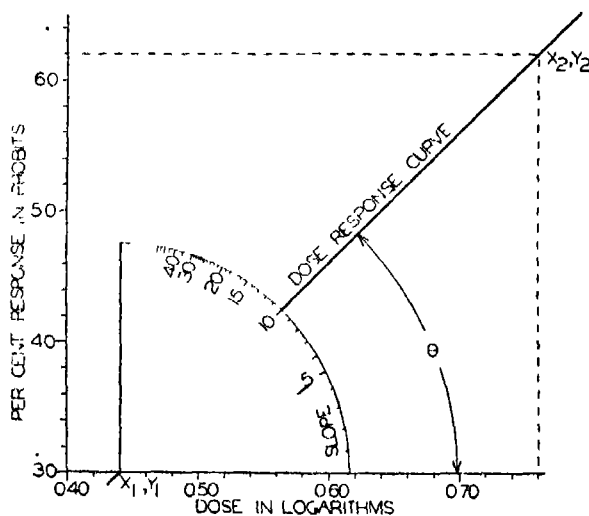


FIG. 1

tables developed by Bliss<sup>1</sup> and then plotting the probits against the log dose.

<sup>1</sup> O. I. Bliss, *Quart. Jour. Pharm. and Pharmacol.*, 11: 192, 1938.

As a practical example, in the graphic calculation of the results of routine biological assays of the all-or-none type it was found convenient to plot all such results on a graph in which each  $x$  or log dose unit was 50 cm long and each  $y$  or probit unit was 5 cm long. Therefore,  $R = 50/5 = 10$ . For making the scale a simple table like that below was constructed. In the

TABLE I

Slope or $b$	Slope/ $R$ or $\tan \theta$	$\theta$ in degrees
1	0.1	5.72
2	0.2	11.32
3	0.3	16.70
⋮	⋮	⋮
60	6.0	80.53

first column a series of consecutive slope figures, such as one may expect to encounter, was written down. The second column, giving the values of the  $\tan \theta$  was calculated by substituting the corresponding slope figures in the equation  $\tan \theta = b/10$ . The values of  $\theta$  were then obtained from a table of tangents, and for convenience the minutes were converted into decimal fractions of degrees by dividing by 60. To mark off the actual divisions on the scale, select a point as the angle zero on a piece of polar coordinate paper which is divided into 360 degrees, and mark off each slope value at the proper number of degrees from zero, using the relationship between the slope values and the corresponding angles as given in the first and last columns of the table. For example, at a distance of  $16.7^\circ$  from zero make a mark corresponding to the slope 3.

This particular scale may be used with any assay providing that on the graph, each  $x$  unit (log dose) is 10 times as long as each  $y$  unit (cc, gm, probit, etc.). For any graph in which  $R$  is not 10 the size of the scale divisions will be different.

To use this protractor-like scale, place the center of the circle of which the slope scale is an arc at the intersection of the dose-response curve with the  $x$  axis and let the zero of the scale also fall on the  $x$  axis. The slope may be read directly from the slope scale at the point at which it is intersected by the straight-line dose-response curve. In the figure, the scale shows that the slope is 10.

A complete graphic treatment of the Bliss<sup>1</sup> method for handling the all-or none type of data will be published in the near future.

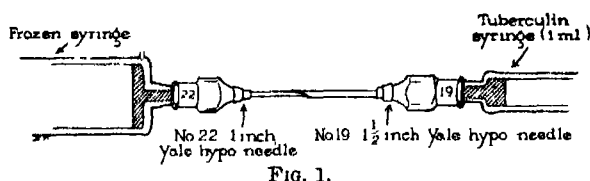
EDWIN J. DEBEER

THE EXPERIMENTAL RESEARCH LABORATORIES,  
BURROUGHS WELLCOME & Co., U. S. A.,  
TUCKAHOE, N. Y.

## MODIFIED HYDRAULIC METHOD FOR REMOVING PLUNGERS FROM "FROZEN" SYRINGES

A METHOD similar to the one described recently by McCoord in *SCIENCE*, volume 94, page 170, has been used by us for several years to remove the plungers of "frozen" syringes. An additional simple device which we use makes the method more convenient and fool-proof. We realize that this modification may already be familiar to some, but feel that since the problem is such a common one in clinical laboratories, any additional improvement is worthy of publicity.

The drawing (Fig. 1) illustrates the method. The



device referred to consists of a number 22 (one inch) Yale hypodermic needle telescoped into a number 19 (one and one-half inch) Yale hypodermic needle so as to make a tight connection. Other tight-fitting combinations of needles may be used and, if desired, the connection may be soldered, although we have not found this necessary. By attaching one end of the device to the "frozen" syringe and the other to a tuberculin syringe filled with water, enough hydraulic pressure can be developed by exerting force on the plunger of the tuberculin syringe to free the barrel. The desired result is almost always attained. The device can be made in a few minutes and can be kept on hand for future use which, in our experience, is frequent.

MILAN NOVAK

COLLEGES OF MEDICINE,  
DENTISTRY AND PHARMACY,  
UNIVERSITY OF ILLINOIS

## BOOKS RECEIVED

- HOLZINGER, KARL J. and HARRY H. HARMAN. *Factor Analysis; A Synthesis of Factorial Methods*. Pp. xii + 417. University of Chicago Press. \$5.00.
- ROY, SHARAT K. *The Upper Ordovician Fauna of Fro-bisher Bay, Baffin Land*. Pp. 212. Illustrated. Field Museum of Natural History. \$3.50.
- SOROKIN, PITIRIM A. *The Crisis of Our Age*. Pp. 338. Illustrated. Dutton. \$3.50.
- WHITING, JOHN W. M. *Becoming a Kwoma; Teaching and Learning in a New Guinea Tribe*. Pp. xix + 226. Yale University Press. \$2.75.
- YOE, JOHN H. and LANDON A. SARVER. *Organic Analytical Reagents*. Pp. ix + 339. Wiley. \$4.00.
- ZECHMEISTER, L. and L. CHOLNOKY. *Principles and Practice of Chromatography*. Pp. xviii + 362. 74 figures. Wiley. \$5.00.

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## THE SIGNIFICANCE OF CHOLINE AS A DIETARY FACTOR<sup>1</sup>

By Professor C. H. BEST

THE UNIVERSITY OF TORONTO

It is particularly appropriate so soon after the very tragic death of my colleague, Sir Frederick Banting, to emphasize the fact that the choline investigations which have already yielded many results of physiological significance, and promise more, are a direct outgrowth of the discovery of insulin. In the light of our present knowledge it was fortunate that, when Professor Macleod and his group initiated studies in which they observed insulin-treated depancreatized animals for several years, an adequate diet was not always used. A great deal of knowledge of the acces-

sory food factors and of other aspects of nutrition has, of course, accumulated since that time. The depancreatized dog suffers from the loss of several of the digestive ferments, and the absorption of food material from the intestine is seriously impaired.

When Allan, Bowie, Macleod and Robinson in Toronto, and Fisher in Chicago noted large yellow livers in the insulin-treated animals, many possible explanations suggested themselves. When it was found that the abnormal condition could be prevented by the inclusion of raw beef pancreas in the diet, it became apparent that some constituent of this tissue was responsible for the improvement. Dr. Hershey,

<sup>1</sup> Abbreviated version of the paper given at the University of Chicago Fiftieth Anniversary Celebration, September, 1941.

first alone and later with Dr. Soskin, working in Professor Macleod's laboratory, studied the effects of feeding crude egg-yolk "lecithin" to the diabetic dogs receiving the diet which favored the production of fatty livers and it became apparent as one watched subsequent experiments that the phospholipid mixture was effective in a manner similar to that of pancreas. The logical inference was, therefore, that the phospholipid fraction or some unidentified substance associated with this material in the pancreas was responsible in part at least for the effect on liver fat.

Experiments on depancreatized dogs are extremely tedious and, in studies of this type, unless a large number of animals are observed, the results are difficult to interpret. In an effort to enlarge more speedily our knowledge of the factors which control fat deposition in the liver, Miss Huntsman, Dr. Hershey and I<sup>2</sup> decided to make studies on the white rat. We investigated the effect of, first, a crude and then a highly purified lecithin on the fatty livers which we found could be produced in the rats by feeding a diet very rich in fat. Purified lecithin turned out to be effective in preventing these fatty livers and sometime later<sup>3</sup> we established the fact that the active constituent of the lecithin was choline. More recently it has been found that as little as 1 mg per rat per day is an effective dose. When given in sufficient amounts to diabetic dogs, choline prevents the development of fatty livers and alleviates the condition when it is administered in curative experiments.<sup>4</sup> It has been shown, however, by Dragstedt and his colleagues that other factors contribute to the effect of the pancreas. This aspect of the subject will be referred to again later. By using a diet which contained much less choline than the mixed ration which previously had been provided, we were able to demonstrate an even more dramatic effect of choline on liver fat in both rats and depancreatized dogs.

In subsequent experiments with Dr. Ridout and Dr. Channon,<sup>5</sup> it was shown that the feeding of choline prevented the deposition of neutral fat and to a lesser extent that of the cholesterol esters in the livers of animals receiving pure cholesterol in their diets. It thus appeared that choline might be involved in the metabolism of cholesterol as well as in that of neutral fat. In curative experiments choline accelerated the removal of cholesterol esters as well as neutral fat from the liver.

*The mechanism of the lipotropic action of choline.*

<sup>2</sup> C. H. Best, J. M. Hershey and M. E. Huntsman, *Jour. Physiol.*, 75: 56-60, 1932.

<sup>3</sup> C. H. Best and M. E. Huntsman, *Jour. Physiol.*, 75: 405-12, 1932.

<sup>4</sup> C. H. Best, G. C. Ferguson and J. M. Hershey, *Jour. Physiol.*, 79: 94-102, 1933.

<sup>5</sup> C. H. Best, H. J. Channon and J. H. Ridout, *Jour. Physiol.*, 81: 409-21, 1934.

To describe the action of choline in the prevention and cure of fatty livers, I suggested some years ago that the term "lipotropic" be used. This has now come into fairly general use and serves to distinguish the effect of choline on fat metabolism from its other physiological actions.

In the very early experiments it was considered possible that choline acted through the formation of phospholipids. Although estimations of phospholipids showed no increase in the amount of these substances in liver tissue, it was realized at that time that there might be a more rapid "turnover" and that this could happen without an increase in the amount present. The first proof that this actually takes place was obtained by Dr. Arnold Welch, who conducted a very ingenious experiment in which he fed arseno-choline (which was lipotropic), and subsequently studied the arsenic content of the phospholipids. He obtained excellent evidence that the dietary substance had entered into combination with the other components of the phospholipid molecule.<sup>6</sup> Chaikoff and his collaborators at Berkeley used radioactive phosphorus as a tracer substance, and their analyses show quite convincingly that choline and the other lipotropic factors accelerated the rate of formation of phospholipids in the liver and other tissues.<sup>7</sup> More recently Stetten obtained similar results by labeling the choline molecule with heavy nitrogen. He was able to detect a high concentration of the isotopic nitrogen in pure choline isolated from the bodies of the choline-fed animals.<sup>8</sup> These results taken together leave little doubt that the mechanism by which the lipotropic effect is produced is by the stimulation of phospholipid interchange between the liver and other tissues. Stetten and Chaikoff found that the liver appeared to be the most active of the various organs.

*Casein and methionine as lipotropic factors.* The lipotropic effect of dietary casein was first noted by Miss Huntsman and myself in 1935. Tucker and Eckstein in 1937 demonstrated that methionine exerted a lipotropic action, both the d and l-methionine being effective. There is still some doubt as to whether casein owes its entire lipotropic action to its methionine content. It is well established that cystine exerts effects on liver fat which are antagonistic to those of choline and methionine.

*The work of du Vigneaud and his colleagues.* In 1939, du Vigneaud, Dyer and Kies found that homocystine or homocysteine was not capable of supporting growth in rats on an amino acid diet devoid of methionine and cystine, and supplemented with thia-

<sup>6</sup> A. DeM. Welch, *Proc. Soc. Exp. Biol. and Med.*, 35: 107-8, 1936.

<sup>7</sup> I. Perlman and I. L. Chaikoff, *Jour. Biol. Chem.*, 127: 211-20, 1939.

<sup>8</sup> DeW. Stetten, Jr., *Jour. Biol. Chem.*, 138: 437-8, 1941.

min, riboflavin, nicotinic acid and ryzamin B as a source of the other B-factors. Rose and Rice found that with better sources of B-factors, growth was satisfactory, indicating that the milk concentrate or tikitiki which they used contained some substance which made possible the utilization of homocystine by rats on a diet deficient in methionine. Very soon after these reports, du Vigneaud, Chandler, Moyer and Keppel<sup>9</sup> proved that choline enables the rat to utilize homocystine for growth purposes, presumably by making possible the *in vivo* methylation of homocystine to methionine. Betaine, which Huntsman, Ridout and I had previously shown to be lipotropic, had an effect similar to choline on the methylation of homocystine.

In a subsequent study, du Vigneaud, Chandler, Cohn and Brown<sup>10</sup> fed methionine labeled with deuterium to immature rats on a diet free from methionine and choline. Choline and creatine isolated from the bodies of these animals contained such a high concentration of the isotope that it is questionable whether any other sources of methyl groups existed in the diet or tissues. Thus this process of "transmethylation" from choline to homocystine and from methionine to choline is established and bids fair to be of tremendous importance in many fundamental biological processes.

The recent finding of Stetten<sup>11</sup> that ethanolamine is a precursor of choline in the body gives promise of further interesting developments. Ethanolamine under the conditions it has thus far been tested, is not lipotropically active, but from the work of du Vigneaud and of Stetten, it does receive methyl groups from methionine to form choline.

*Griffith's work on the relation of choline to hemorrhagic degeneration of the kidneys in young rats.* Additional evidence of the importance of dietary choline has been provided by the studies of Griffith and his collaborators, who noticed hemorrhagic degeneration of the kidneys in young male rats which were fed on diets containing an apparently adequate amount of protein, and dietary essentials other than choline. These young animals, which were from 21 to 26 days of age, developed the characteristic fatty livers which have been referred to above, within 48 hours. Griffith noted in addition to the fatty livers, severe hemorrhagic degeneration of the kidneys, ocular hemorrhages and a regression of the thymus gland. Griffith<sup>12</sup> and Griffith and Mulford<sup>13</sup> have shown that the hemorrhagic degeneration is prevented by methionine and

betaine as well as by choline. It is aggravated by feeding cystine or cholesterol. In a recent article Griffith and Mulford,<sup>14</sup> have emphasized the fact that the renal changes or the fatty livers do not appear if the food intake is restricted. Griffith has also suggested that the rate of metabolism or of growth may be the basis for the apparent antagonism between choline and cystine, and suggests that on diets which are inadequate in the S-containing amino acids added cystine improves the nutritional state, and for this reason, extra choline is required.

The mechanism by which choline and the other lipotropic factors prevent these hemorrhagic lesions in the kidney and other organs is not well established. The fact, however, that the lesions are augmented by cystine and by cholesterol and prevented by the naturally occurring lipotropic factors choline, betaine and methionine makes a picture so similar to that seen in the studies on the liver that it seems reasonable to assume that the same or a very closely related mechanism is operating.

*Jukes' work on the relation of choline to avian nutrition.* Under certain experimental conditions, a shortening and thickening of the bones, particularly noticeable in the tarsus and tibia of young birds, is produced when certain diets are provided. This condition is known as perosis. In many cases a distortion and dislocation of the hock joint results, and the slipping of the tendo calcaneus has provided the basis for the term "slipped tendon" disease. In 1936 it was shown that perosis may be caused by a deficiency of manganese. In 1940, however, Jukes<sup>15</sup> showed that when the supply of manganese was adequate, perosis was not prevented unless choline was also supplied in the diet.

The effect of choline in preventing perosis has been observed in both chicks and young turkeys. There is a very interesting interrelationship between choline and glycine deficiency in so far as perosis is concerned. On a diet deficient in both choline and glycine, perosis does not appear in chicks. If glycine is added to the diet, perosis is produced and if choline is then given, the condition is alleviated.<sup>16</sup>

Jukes has suggested as a possible explanation for these observations on the effects of choline and glycine that the glycine, which is a precursor of creatine, prevents the appearance of muscular dystrophy. The perosis is not seen in the presence of the muscular dystrophy presumably because there is less pull of the muscles on the bones in this condition. Creatine will produce perosis when added to a diet deficient in both glycine and choline.

<sup>9</sup> V. du Vigneaud, J. P. Chandler, A. W. Moyer and D. M. Keppel, *Jour. Biol. Chem.*, 131: 57-76, 1939.

<sup>10</sup> V. du Vigneaud, J. P. Chandler, M. Cohn and G. B. Brown, *Jour. Biol. Chem.*, 134: 787-8, 1940.

<sup>11</sup> DeW. Stetten, Jr., *Jour. Biol. Chem.*, 140: cxvii, 1941.

<sup>12</sup> W. H. Griffith, *Jour. Nutrition*, 21: 291-306, 1941.

<sup>13</sup> W. H. Griffith and D. J. Mulford, *Jour. Am. Chem. Soc.*, 63: 929-32, 1941.

<sup>14</sup> *Ibid.*, *Jour. Nutrition*, 21: 633-45, 1941.

<sup>15</sup> T. H. Jukes, *Jour. Nutrition*, 20: 445-58, 1940.

<sup>16</sup> *Ibid.*, *Jour. Nutrition*, 21: P13, 1941.

Jukes has obtained evidence by adding certain analogues of choline to diets deficient in this substance, that the growth-promoting and anti-perotic properties of choline are truly distinct. He has found that methyl-diethyl-choline and beta-methyl-choline will protect against perosis but do not promote growth. On the other hand, betaine and betaine aldehyde promote growth but are devoid of anti-perotic activity for chicks. These results link choline with the metabolism of either muscle or bone—perhaps with both.

*The work of McHenry and his colleagues.* In 1935, Best, Huntsman, McHenry and Ridout<sup>17</sup> reported a favorable influence of choline on the gain in weight of young rats receiving a diet low in lipotropic factors and rich in fat. Subsequently McHenry and his colleagues working independently in my department have made several extremely important additions to our knowledge of the choline field. In 1936, McHenry<sup>18</sup> reported an apparent relationship between thiamin and choline in the production of fatty livers. In thiamin deficient animals, without thiamin in the diet, fat does not accumulate in the liver in the absence of dietary lipotropic factors unless liberal amounts of fat are supplied. With thiamin and without fat in the diet, fat formed from carbohydrate is deposited in the liver. This fat is rich in glycerides and low in cholesterol and its deposition is prevented by the administration of small amounts of choline. Other members of the B-complex, riboflavin and pyridoxine, also increase the deposition of fat in the liver but not unless thiamin is also supplied.<sup>19</sup> An interesting question has been raised by Griffith. Is the thiamin-choline antagonism a specific one, or is the action of thiamin merely to raise the "level of nutrition" to a point where choline can act? Animals receiving a low caloric intake do not show signs of choline deficiency when an abundance of thiamin is available. On the other hand, the only way in which the nutritional state of an animal suffering from thiamin deficiency can be restored to normal is by providing the specific substance. The fact, however, that diets rich in fat produce fatty livers in the absence of thiamin, may suggest an answer to one aspect of the problem. It is obvious that if fat is not presented sufficiently rapidly to the liver to produce an accumulation, the action of choline in preventing this can not be demonstrated. Food intake, particularly fat intake, and the conversion of sugar to fat, presumably in the liver under the influence of thiamin, will work together to control the amount of substrate upon which choline acts. The ability of the liver cells to metabolize the

fat depends, of course, on other factors as well as on the concentration of the lipotropic substances available.

*The effect of choline upon the deposition of fat produced by chemical agents or by hormones.* When fatty livers are produced by phosphorus poisoning or by one of the many other chemicals which have this effect, the deposition of fat is not prevented by the lipotropic factors. It is true, however, that the rate of disappearance of the fat from the phosphorus poisoned liver is accelerated when choline is supplied.<sup>20</sup> The same is true of the fatty liver produced by carbon tetrachloride poisoning.<sup>21</sup> Neither the acute fatty liver produced by the factor in the anterior pituitary gland,<sup>22</sup> nor the deposition of cholesterol and neutral fat caused by the feeding of biotin<sup>23</sup> is readily affected by choline. It is thus apparent that there are various types of fatty liver, and that those upon which the lipotropic factors act with characteristic rapidity are produced by a deficiency of these substances in the diet.

*The preliminary work of Solandt on acetylcholine production.* Several years ago, D. Y. Solandt and I discussed repeatedly the possibility that choline as a dietary factor might control the amount of neuro-humor, acetylcholine available. While the results of preliminary work along this line were not satisfactorily consistent, it was found in some series that stimulation of the vagus nerve produced less effect in choline-deficient rats than in controls receiving the same ration plus choline.<sup>24</sup> Furthermore, it was possible to restore the vagus effect by the intravenous injection of choline in these animals. This problem demands a great deal of further work, but if a definite connection between the amount of choline or its precursors in the diet and the liberation of acetylcholine can be established, this will become one of the most important aspects of this subject.

*The work of Dragstedt and his collaborators on the prevention of fatty livers in depancreatized dogs.* The work of Dr. Dragstedt and his colleagues on lipocaic is undoubtedly closely related physiologically to the studies on choline. It now appears certain, however, that the active material in which Dr. Dragstedt is particularly interested is not choline. My colleague, Dr. McHenry, has suggested that the activity of lipocaic in rats may be in part due to inositol, but we are all agreed that the experiments on normal

<sup>20</sup> C. H. Best, D. L. MacLean and J. H. Ridout, *Jour. Physiol.*, 83: 275-84, 1935.

<sup>21</sup> H. M. Barrot, C. H. Best, D. L. MacLean and J. H. Ridout, *Jour. Physiol.*, 97: 103-6, 1939.

<sup>22</sup> C. H. Best and J. Campbell, *Jour. Physiol.*, 92: 91-110, 1938.

<sup>23</sup> E. W. McHenry and G. Gavin, *Jour. Biol. Chem.*, 140: lxxxvii, 1941.

<sup>24</sup> D. Y. Solandt and C. H. Best, *Nature*, 144: 376, 1939.

<sup>17</sup> C. H. Best, M. E. Huntsman, E. W. McHenry and J. H. Ridout, *Jour. Physiol.*, 84: 38P, 1935.

<sup>18</sup> E. W. McHenry, *Jour. Physiol.*, 86: 27P-28P, 1936.

<sup>19</sup> G. Gavin and E. W. McHenry, *Jour. Biol. Chem.*, 132: 41-46, 1940.

rats do not necessarily yield results which can be applied to the depancreatized dog. It may be that inositol is one of the active constituents of lipocaine which affects depancreatized dogs, or it may be that other active fractions are present. The extracts of pancreas, as McHenry and Gavin have shown, affect the fatty liver produced by feeding biotin. This "biotin" fatty liver is characterized by a high content of cholesterol as well as of neutral fat. Choline affects cholesterol esters more slowly than neutral fat, and very large doses are required. The action of some active principle in lipocaine is much more rapid.

McHenry has advanced reasons for believing that the fatty liver of the depancreatized dog is of the biotin type. Without doubt there is evidence that cholesterol esters are deposited in increased amounts in the fatty liver of the depancreatized dog. Ralli and her collaborators<sup>25</sup> did not obtain fatty livers in depancreatized dogs fed on a diet from which the biotin fraction was presumably in part extracted. On the other hand, I feel that there is also good evidence that the fatty liver of a depancreatized dog is of the type due to the deficiency of choline. It is quite probable that both types may exist together.

It is important to emphasize the fact here that in the absence of the pancreatic enzymes, the amount of dietary choline, methionine or of other lipotropic factors absorbed from the intestine may be appreciably diminished, and this situation may in part be corrected by providing the pancreatic enzymes in the diet. We

have emphasized this possibility previously and Chaikoff, quite independently, has stressed the same point.

Dr. Dragstedt feels that he will eventually convince even the most skeptical that lipocaine is a second internal secretion of the pancreas. I suppose this would be even more interesting than the demonstration that another dietary factor is involved in the prevention of fatty livers in depancreatized dogs. I would like to take this opportunity to wish Dr. Dragstedt and his colleagues every success in their further work.

In review, let me outline the main trends of the choline investigations. It is apparent that choline is a growth factor; it profoundly affects fat transport and more indirectly carbohydrate metabolism; it may be formed when the methyl groups of methionine are presented to ethanolamine; it provides methyl groups for homocystine and perhaps for other substances; it is thus involved in protein metabolism. It prevents hemorrhagic kidney degeneration and other lesions in young rats and perosis in chicks and turkeys. Lastly, it is one of the factors in pancreas which prevents the development of fatty livers in depancreatized dogs.

In this article I have not attempted to do more than to sketch a picture, the details of which can not be filled in at this time. There are many gaps in my presentation of the known facts, but it will perhaps serve to indicate the possibilities of augmenting our knowledge of fat metabolism by further studies on choline and the other lipotropic factors.

## THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

### PRELIMINARY ANNOUNCEMENT OF THE DALLAS MEETING

#### II

Edited by Dr. F. R. MOULTON

PERMANENT SECRETARY

#### SECTION AND SOCIETY PROGRAMS

*Section on Mathematics* (December 29, 30) on Monday morning will hold a joint session with the Institute of Mathematical Statistics and the Econometric Society. In the afternoon A. B. Coble, of the University of Illinois, will deliver his address as retiring vice president for the section on "A Certain Set of Ten Points in Space." The sessions on Tuesday will be for the presentation of contributed papers.

*Section on Physics and the American Association of Physics Teachers* (December 29, 30) will hold four sessions for the presentation of papers. On Monday morning the society will hold a session at

which four contributed papers will be presented. On Monday afternoon the section and the society will hold a joint session at which Arthur L. Hughes, chairman of the section, will deliver his address as retiring vice president of the association on "Applications of Electron Scattering." Following the address of Dr. Hughes, V. K. Zworykin and J. Hillier will present a paper on "Stereo-Microscopy with the Electron Microscope" and A. Glenn Richards, Jr., and Thomas F. Anderson will present their results on "Electron Micrograph Studies of Insect Structures."

The program on Tuesday will consist of two joint sessions at which only invited papers will be presented.

<sup>25</sup> E. P. Ralli and W. H. Rubin, *Proc. Soc. Exp. Biol. and Med.*, 43: 601-3, 1940.

*Section on Chemistry* (December 29-31) will present three symposia under the chairmanship of Dr. Edward A. Doisy, vice president of the association for the section, and join in a dinner on Monday evening in honor of Dr. George Seatchard, who will deliver an address as a retiring vice president of the association on "The Applications of Physical Chemistry to Biological Problems."

"Biochemistry" is the subject of the first symposium, at which 10 papers will be presented. They pertain to such subjects as manifestations of nutritional deficiencies, recent work on the vitamin B complex, amino acids and clinical effects of several vitamins, hormones and amino acids on tumors in rodents and inoperable tumors in man.

The second symposium is on "Spectrographic Analysis," at which 11 papers will be presented. They range from applications in the steel industry to determining the constitutions of the stars. They include contributions to such subjects of theoretical and practical interest as spectro-chemical methods for non-metallic analysis, ultraviolet absorption in organic molecules, the photoelectric spectrophotometer and gas analysis with the mass-spectrometer.

The third symposium is on the "Petroleum Industry," at which 9 papers will be presented. They cover chemical and geological aspects of the subject widely from the question of the origin of oil pools to the utilization of petroleum products in industry and in national defense.

*Section on Astronomy* (December 30, 31) will hold four sessions, primarily for the presentation of invited papers, including "Photometry of the Night Sky," by C. T. Elvey, of the McDonald Observatory; "Time Determination and Time Keeping," by Paul Sollenberger, of the Time Service of the U. S. Naval Observatory; "Problems of Nebular Research," by Edwin P. Hubble, of the Mount Wilson Observatory; "Progress in Eclipse Work," including colored moving pictures of the 1940 expedition to Brazil, by Paul A. McNally, of the Georgetown College Observatory; "Stellar Photometry," by L. V. Robinson, of the University of Mississippi; "Solar-Terrestrial Relationships," by H. T. Stetson, of the Massachusetts Institute of Technology, and "Progress in Planetary Research," by E. C. Slipher, of the Lowell Observatory. In addition, there will be a symposium on "Problems of Teaching Astronomy with Special Reference to Observational and Demonstration Equipment." An illustrated lecture on the planets with special attention to the recent close approach of Mars to the earth will be delivered by E. C. Slipher, of the Lowell Observatory. Robert R. McMath, chairman of the section, will deliver his address as retiring vice president of the association.

*Section on Geology and Geography* (December 29-31) in cooperation with the Geological Society of America, the American Geophysical Union, the Texas Academy of Science, the Dallas Petroleum Geologists, the Fort Worth Geological Society and the Association of American Geographers, will hold 6 sessions at which 40 papers will be presented.

On Monday, the morning session will be devoted to general geologic papers and to addresses by Charles N. Gould and Elmer H. Johnson, who will review contributions made by scientists from the southwestern states to geology and geography. Then will follow the feature of the session, the address by Hugh D. Miser, retiring vice president of the association and chairman of the section, on "Quartz Veins of the Ouachita Mountains of Arkansas and Oklahoma."

A symposium on the "Stratigraphy and Structure of the Southwest," arranged by a committee of which Charles L. Baker, of Texas A. and M. College, is chairman, will be held on Monday afternoon. Eight papers dealing with fundamental field problems of sedimentation and tectonics will be presented.

On Tuesday morning, under the joint sponsorship of the section and the American Geophysical Union, the work carried on for several years in the southwestern states by the Ground-Water Division of the U. S. Geological Survey and cooperating agencies will be reviewed. At this session a series of invited papers will be presented. The symposium will be introduced by O. E. Meinzer, who will outline the various types of problems which the subsequent papers will illustrate and elaborate.

On Tuesday afternoon the section will join with the Section on Anthropology for a series of papers on the present status of knowledge regarding Early Man. Representatives of the two sections have cooperated in the development of this program. A coordinated series of exhibits is being planned.

The geographic session on Wednesday has been developed by a committee of which Edwin J. Foscue, of Southern Methodist University, designated as the representative of the Association of American Geographers, is chairman. Six major papers will deal with geographic problems in the Southwest, ranging in scope from demography to land-use. It is tentatively planned that the papers will be followed by a round-table discussion on Southwestern Geography.

The Houston Geological Society has been invited to display its remarkable exhibit on petroleum geology. The committee which planned the Early Man symposium is also projecting an exhibit of artifacts and faunal associations. Other exhibits of geological and geographical materials and of teaching techniques are in preparation.

*Section on Zoological Sciences* (December 30) will

join with its affiliated societies in their programs and in the annual dinner of the American Society of Zoologists, after which John T. Patterson, chairman of the section, will deliver an address as vice president of the association, on "Drosophila and Speciation."

*American Society of Zoologists* (December 29-31) will participate with other societies in holding three symposia and in sponsoring the Biologists' Smoker, and on Tuesday evening it will hold its annual dinner to which all zoologists and friends are invited.

On Monday morning the society will hold a symposium on "The Genetic Control of Embryonic Development," at which papers will be presented by V. C. Twitty, of Stanford University, V. Hamburger, of Washington University, and Sewall Wright, of The University of Chicago. On Monday afternoon the society, in cooperation with the Botanical Society of America, the Ecological Society of America and the Genetics Society of America, will hold a symposium on "Isolating Mechanisms," at which papers will be presented by C. Ledyard Stebbins, Jr., of the University of California, Albert P. Blair, of Tulsa, Oklahoma, Alfred C. Kinsey, of Indiana University, and John T. Patterson, of the University of Texas.

The society, the Botanical Society of America and the Ecological Society of America will hold a symposium on "Temperature and Evolution" in two joint sessions, the former on Tuesday morning and the latter on Wednesday morning. At the Tuesday morning session papers will be presented by H. H. Plough, of Amherst College, G. Fankhauser, of Princeton University, George P. Child, of Amherst College, and Emil Witschi, of the University of Iowa. At the Wednesday morning session papers will be presented by H. J. Muller, of Amherst College, Walter Landauer, of the University of Connecticut, Alfred C. Kinsey, of Indiana University, and John A. Moore, of Queens College.

In the final session on Wednesday afternoon the society will participate with the American Society of Naturalists, the Genetics Society of America and the Botanical Society of America in holding a symposium on "Human Genetics," which was organized by Laurence H. Snyder, of Ohio State University. The contributors to this symposium are Laurence H. Snyder, of Ohio State University; H. H. Strandkov, of The University of Chicago; Charles W. Cotterman, of the University of Michigan; and L. S. Penrose, of Ontario Hospital.

*American Society of Parasitologists* (December 29-31) will present a program consisting of 58 papers and demonstrations representing the fields of protozoology, helminthology and medical entomology. At the Tuesday morning session, at 11 o'clock, James E. Aekert, president of the society, will deliver an address

on "Natural Resistance to Helminthic Infections." On Tuesday noon the society will hold a luncheon, followed by its annual business meeting. At the demonstration program on Tuesday afternoon tea will be served.

*The Section on the Botanical Sciences* (December 30) will hold a joint session on Tuesday afternoon with the Botanical Society of America, American Phytopathological Society, American Fern Society, Sullivant Moss Society, Mycological Society of America and American Society of Plant Taxonomists, at which M. L. Fernald, chairman of the section, will deliver his address as retiring vice president of the association on "Some Historical Aspects of Plant Taxonomy." The remainder of the session consists of invited papers by R. W. Chaney, W. H. Camp and L. J. Stadler on "Plant Distribution During the Past Fifty Million Years," "The Individual in Relation to Complex Populations in *Vaccinium*," and "Some Experiments in Gene Mutation," respectively.

*Botanical Society of America* (December 29-31) has organized programs for the presentation of papers under the General, Paleobotanical, Physiological and Systematic Sections of the society. In addition, the society will hold two symposia on the teaching of plant science, and it will join with other societies in symposia on "The Origin and Development of Floras of the Southwest," "Isolating Mechanisms," "Temperature and Evolution," and "Experimental Design and the Control and Measurement in Physiological Investigations."

*The American Phytopathological Society* (December 29-January 1) will hold its 33d annual meeting at the Hotel Adolphus. The program will consist of six sessions of the society for the presentation of papers, one demonstration session, three joint sessions with other societies for the presentation of papers, three conferences on special subjects and the annual dinner of the society on Tuesday evening. A distinguished foreign colleague, Dr. A. A. Bitancourt, of the Instituto Biologico de São Paulo, Brazil, will present a paper on "New Species of Sphaceloma on Myrtaceae." Dr. Bitancourt has been a member of the association since 1934.

The program of the society will begin with a business meeting on Monday morning, followed by three simultaneous sessions in the afternoon for discussions of "Fungicides and Fruit Diseases," "Virus and Tobacco Diseases" and "Small Grain Diseases," respectively. A conference on "Quarantines in Relation to Virus Diseases" is tentatively scheduled for the evening. On Tuesday morning two simultaneous sessions are planned for the consideration of "Corn and Sorghum Diseases" and "Truck Crop Diseases." On Tuesday afternoon the society will hold a joint ses-

sion with the Section on Botanical Sciences and simultaneously a conference sponsored by the extension plant pathologists on "Plant Pathology in Relation to National Defense and Post-war Readjustments." On the same afternoon a demonstration session will be held.

On Wednesday afternoon the society will hold a joint session with the Potato Association of America and a conference on "Seed Treatment Experiments" under the direction of the Committee for Coordination of Research in Cereal and Vegetable Seed Treatments. Reports will be presented on vegetable seed treatments, cotton seed treatments and cereal seed treatments. In addition, tentative plans have been made for a simultaneous session on "Forest Tree Diseases," followed by a session on diseases of southern and miscellaneous crops.

Members of the American Phytopathological Society will present approximately 103 papers at these sessions.

*The Mycological Society of America* (Dec. 30) will hold a session on Tuesday morning at which Ernst A. Bessey will deliver his presidential address on "Some Problems in Fungus Phylogeny." The society will present three symposia: (1) "Soil Fungi and their Activities," (2) "Fungi Pathogenic to Man and Animals" and (3) "Sex and Genetics of Fungi."

*Sullivant Moss Society* (December 31) will hold a session in both the morning and the afternoon for the presentation of papers.

*The American Fern Society* (January 1) will hold a session on Thursday morning, at which Joseph Ewan, president of the society, will deliver an address on "Problems Suggested by Field Work with the Aquatic Pteridophyta of Colorado." On Tuesday afternoon the society will join in the meeting of the Botanical Society of America.

*American Society of Plant Taxonomists* (December 29-31) will join with the Systematic Section of the Botanical Society of America in a session for the presentation of papers and will hold its annual dinner on Monday evening.

*American Society of Naturalists* (December 30, 31) will hold a joint session on Wednesday afternoon with related zoological and botanical sciences at which a symposium on "Human Genetics" will be presented. This symposium, consisting of 4 papers, was organized by Laurence H. Snyder. On Wednesday evening the society will hold the annual Naturalists' Dinner, at which W. W. Cort will deliver his presidential address on "Human Factors in Parasite Ecology." In conformity with custom, the society will arrange for the annual Biologists' Smoker, which will be held on Tuesday evening.

*Ecological Society of America* (December 29-31)

on Monday afternoon will hold a joint session with the American Society of Zoologists, the Botanical Society of America and the Genetics Society of America in a symposium on "Isolating Mechanisms." On Tuesday and Wednesday mornings the society will join the American Society of Zoologists in sponsoring a symposium on "Temperature and Evolution." A joint session with the Limnological Society of America will be held Tuesday afternoon. The annual banquet of the society, to which all interested biologists are invited, will be held on Monday evening, at which A. E. Emerson, the retiring president of the society, will speak.

*The Genetics Society of America* (December 29-31) will hold two symposia, two sessions for the presentation of papers, one session for a demonstration program and, at Tuesday noon, its annual luncheon and business meeting.

On Monday afternoon the society will join the American Society of Zoologists, the Botanical Society of America and the Ecological Society of America in holding a symposium on "Isolating Mechanisms," under the chairmanship of John T. Patterson, vice president of the association for the Section on Zoological Sciences. On Wednesday afternoon the society will participate in the symposium on "Human Genetics," which will be held under the chairmanship of W. W. Cort, and at which papers will be presented by L. H. Snyder, H. H. Strandkov, C. W. Cotterman and L. S. Penrose. At a special invitation program papers will be presented by G. B. Mainland, G. W. Beadle and E. L. Tatum, H. Roman, T. M. Sonneborn, A. W. Pollister and A. E. Mirsky and J. S. Gowen.

*The American Microscopical Society* (December 29) will hold its executive luncheon at noon and its annual business meeting at 4 P.M.

*The Limnological Society of America* (December 29-31) will hold its seventh annual meeting at Dallas. Both society headquarters and session meetings will be in the Jefferson Hotel. The first two days, Monday and Tuesday, are reserved for programs for the presentation of research papers. The session of Tuesday afternoon will be a joint meeting with the Ecological Society of America. Forty papers are to be presented during the two days; in addition, 13 papers appear on the program to be read by title only. The program for Monday forenoon and afternoon consists of papers of general limnological interest; that for Tuesday forenoon is composed largely of papers dealing with limnology as related to the various problems of fish and fisheries biology. On the program for the joint meeting with the Ecological Society will appear limnological papers having very general interest. The annual business meeting

of the society will occur at the close of the Tuesday forenoon session. Wednesday will be devoted to an all-day field trip to Eagle Mountain Lake and other points of limnological interest, under the leadership of local limnologists.

*National Association of Biology Teachers* (December 29) will hold two sessions for the presentation of papers and a dinner in the evening at which Walter F. Loehwing, of the University of Iowa, will deliver an address. The ten contributed papers cover a wide range of subjects of interest to teachers of biology.

*Phi Sigma Society* (January 1, 2) will hold sessions for the presentation of papers and a dinner, probably on Friday evening.

*Beta Beta Beta Honorary Biological Fraternity* (December 31) will have a luncheon on Wednesday in the Hotel Adolphus, after which Dr. C. E. McClung, president of the society, will deliver an address, at the conclusion of which a business session will be held.

*Union of American Biological Societies* (December 29) will hold its annual business meeting on Monday at 4 P.M.

*Section on Anthropology* (December 29, 30) will hold four sessions at which two major themes will be stressed: the archeology and culture areas of the Southeastern United States; and problems relating to early man with special reference to North America. The symposium on "Early Man" will be held jointly with the Section on Geology and Geography at the Tuesday afternoon session. E. B. Howard will outline the present status of the Folsom-Yuma problem. E. B. Sellards will discuss terrace deposits in the chronology of early man. R. M. Adams will report on early man in Missouri; A. O. Bowden and I. A. Lopatin, in California; C. W. Cooke, in Florida; M. S. Goldstein and G. L. Evans, in Texas, and F. C. Hibben, in Alaska. Contributors to the discussion of the Southeastern United States will include anthropologists from the Universities of Texas, Tennessee and Kentucky. There will be one session devoted to anthropometry, with papers by E. W. Count, T. H. Evans and others. Dr. W. Duncan Strong, chairman of the section, will deliver an address as retiring vice president of the association.

*Section on Psychology* (December 29, 30) beginning on Monday morning will hold a symposium on "Recent Advances in the Appraisal of Personality" under the chairmanship of Ernest R. Hilgard, of Stanford University. The subject of the symposium was selected in conformity with the suggestion of President Blakeslee that the *leit motif* of the meeting in Dallas be "Individuality" so far as might be practicable. The participants in this symposium include Pearl Bretnall,

of Tulane University; Doncaster G. Humm, of Los Angeles; Frank A. Peattie, of Rice Institute, and Dael Wolfe, of The University of Chicago.

On Tuesday the section will hold a joint symposium with the Section on Education on "The Psychology of Learning and the Educative Process," under the chairmanship of H. T. Manuel, of the University of Texas. The participants for the psychologists will be John A. McGeoch, of the State University of Iowa; Norman L. Munn, of Vanderbilt University, and Ernest R. Hilgard, of Stanford University. The participants representing the Section on Education will be A. A. Barr, of the University of Wisconsin; Harold F. Clark, of Columbia University, and H. Meltzer, of Psychological Service Center, St. Louis, Mo.

In addition to the symposia there will be two or more sessions for contributed papers.

The Section on Psychology and the Section on Education will join in a dinner on Tuesday evening at which Karl M. Dallenbach, chairman of the section, will deliver an address as a retiring vice president of the association. E. J. Ashbaugh, of Miami University, vice president of the association for the Section on Education, will also deliver an address.

*The Section on Social and Economic Sciences* (December 29-31) will present a program consisting of 6 sessions. The first session, in charge of a committee of Texas A. and M. College, will prepare the way for the 5 other sessions by presenting a general frame of information about the Southwest, including its human and natural resources and the changing pattern of its agricultural and industrial life. The second session, organized by A. B. Cox, of the University of Texas, will show how industry is developing in the Southwest and raising new problems.

The third and fourth sessions will be concerned with interracial problems, the former between Negroes and Whites and the latter between Spanish-Americans and Whites, that are arising because of the changing economy and conditions in Texas and adjacent territory. The former of these programs is under the charge of Daniel Russell, of Texas A. and M., and the latter is under the charge of George Sanchez, of the University of Texas.

One of the subjects of the fifth session, which is being organized in cooperation with the Office of Indian Affairs, will be the place of Indians in the economy of the Southwest and related problems. The final session, in charge of Earl O. Mills, regional counselor of the National Resources Planning Board, will be devoted to discussions of the plans that are being developed to meet the problems that are arising in the Southwest.

*Metric Association* (December 30) will hold a dinner meeting on Tuesday, at which there will be discussion

by the delegates from recently organized departments of the society, followed by its annual business meeting and discussion of plans for next year.

*The National Social Science Honor Society, Pi Gamma Mu, Inc.*, (December 31) will hold its annual social science luncheon on Wednesday, at which brief addresses will be delivered.

*The Section on Engineering* (December 31) will hold two sessions for the delivery of addresses and the presentation of papers. At the morning session, Dean Robert L. Suckett, retiring vice president of the association, will deliver an address. It is expected that C. M. A. Stine, of the Du Pont Company, John Suman, president of the A. I. M. E., and Everett De Golyer, will present papers, and Ross White, chief engineer for dam construction for the TVA, will present a paper. Dr. M. J. Thompson will review the present status of the aeronautical industry and attempt to project present developments beyond the present emergency.

*The Section on Medical Sciences* (December 30, 31) will present a symposium on "Relapsing Fever" in human beings as it exists in the United States and the Canal Zone. Twenty papers will be presented, beginning with a biographical sketch of Otto Obermeier, who detected spirochetes that were later proved to be the causative agents of the European disease. Other papers will discuss the present distribution of relapsing fever in certain southern and western states, the taxonomy of the spirochete, its performance on laboratory media, tick vectors and various clinical and laboratory aspects of relapsing fever. It is expected that these papers will be published as one of the association's symposia volumes on important public health diseases.

In addition, the section will hold sessions on December 31 for the presentation of papers on diverse problems of medical interest. At one of these sessions, Dr. Ernest W. Goodpasture, chairman of the section, will deliver his address as retiring vice president of the association.

*Subsection on Dentistry of the Section on Medical Sciences* (December 29, 30) will present a symposium on "Public Health Aspects of Dentistry, with special Reference to Fluorine." Such authorities on the subject as Frederick S. McKay, H. T. Dean, Philip Jay, Isaac Schour, Wallace Armstrong, Gerald Cox and C. F. Deatherage will present papers on the program.

*Subsection on Pharmacy of the Section on Medical Sciences* (December 29) will hold morning and afternoon sessions on Monday for the presentation of papers.

*American Society for Horticultural Science* (December 29-31), beginning on Monday afternoon, will

hold four joint sessions with other societies for the holding of symposia and the presentation of papers.

On Monday afternoon the Vegetable Section of the society will hold a joint session with the Potato Association of America for the presentation of papers on "Potato Breeding, Physiology and Production." On Tuesday morning the society will hold a joint session with the Section on Agriculture, at which W. H. Chandler, the chairman of the section, will deliver his address as retiring vice president of the association on "Forty Years of Helping the Farmer with Knowledge." At the same session several papers will be presented on various questions of reproduction and fruitfulness in horticultural plants.

On Tuesday afternoon the society will hold a joint symposium with the American Society of Plant Physiologists and the Physiology Section of the Botanical Society of America on "Experimental Design and Control and Measurement of Variation in Physiological Research." On Wednesday morning the society will join with the Biometrics Section of the American Statistical Association in holding a symposium on "Efficiency in Recent Methods for Controlling Field Heterogeneity."

At the annual banquet of the society on Tuesday evening F. C. Bradford, president of the society, will deliver an address on "Retaining What We Have."

*Potato Association of America* (December 29-31) will hold joint sessions with the American Society for Horticultural Science and with the American Phytopathological Society for the presentation of papers, in addition to independent sessions for the presentation of papers.

*Section on Education* (December 30, 31) will hold a joint session with the Section on Psychology, a symposium on conservation problems, which is being arranged by a local committee, a joint dinner, as usual, with the Section on Psychology and two sessions for the presentation of general papers.

At the joint session with the psychologists A. S. Barr, of the University of Wisconsin, will present a paper on "The Teacher and the Education Process"; Harold F. Clark, of Columbia University, on "The Effect of Diet on Learning"; and H. Meltzer, of Psychological Center, St. Louis, on "Education and the Learning Process." Among other participants in the program are Oliver S. Loud, of Teachers College; R. W. Lynch, of Oklahoma A. and M. College; and Stuart E. Noble, of Tulane University of Louisiana. Dr. Noble's paper will be on "Progress in the Elimination of Illiteracy in the South."

*The Society of the Sigma Xi* (December 30) will hold the business meeting of its forty-second annual convention on Tuesday afternoon. On Tuesday eve-

ning, in cooperation with the association, it will present as its speaker for its twentieth annual Sigma Xi Lecture Dr. Edwin P. Hubble, of the Mount Wilson Observatory, who will deliver an address on "The Expanding Universe Theory."

*United Chapters of Phi Beta Kappa* (December 31) on Wednesday evening will present as the speaker for its seventh annual Phi Beta Kappa lecture Dean Christian Gauss, of Princeton University, who will deliver an address on, "Can We Educate for Democracy?"

*American Science Teachers Association* (December 30) will hold sessions on Tuesday, the morning session jointly with the American Nature Study Society. On Tuesday noon the society will hold a luncheon at which Irving Langmuir, president of the association, will speak.

*American Nature Study Society* (December 30, 31) will hold four sessions for the presentation of papers and a breakfast on Wednesday morning. The session on Tuesday morning will be held jointly with the American Science Teachers Association, at which

Irving Langmuir, president of the association, will speak.

*The Honor Society of Phi Kappa Phi* (December 30) will hold its biennial meeting at 1:30 P.M. on Tuesday and on Wednesday morning. On Wednesday a breakfast will be held at 8:00 A.M., followed by a short business session. At 5:00 P.M. on Wednesday the society will provide a public lecture by Dr. Rufus B. von KleinSmid, president of the University of Southern California and president of Phi Kappa Phi.

*Gamma Alpha Graduate Scientific Fraternity* (December 30) will hold a meeting of its executive committee on Tuesday morning, its convention luncheon on Tuesday noon and a business meeting of the council and the election of officers on Tuesday afternoon.

*Sigma Delta Epsilon, Graduate Women's Scientific Fraternity* (December 29-January 1) will hold its national council meeting on Monday morning, a luncheon for all women in science at noon on Tuesday, a breakfast and its annual business meeting on Wednesday morning and a second national council meeting on Thursday afternoon.

## OBITUARY

### CHARLES PECHER

IN the death of Charles Pecher at the age of twenty-eight experimental medicine has lost a brilliant investigator who already had made important contributions in the application of nuclear physics to biology and medicine.

Dr. Pecher was born in Antwerp, Belgium, on November 26, 1913, his father being the Minister of Colonies. In 1923 he graduated from the *Athenée Royal* of Antwerp, and in 1939 received his doctor's degree from the University of Brussels with great distinction. From 1935 to 1939 he was laboratory assistant in physiology under Professor Rylant, and it was during this period that he did his first experimental work in biophysics. Also during this time he became interested in the biological applications of the newly discovered radioactive substances. Because of his interest in this field and because of his high standing in his class at medical school (having been awarded the Armand Kleefeld Prize, which is awarded each year to the medical student who has had the highest average in his course) he was awarded the fellowship of the Belgian American Foundation to study in the United States.

During the fall of 1939 he worked in association with Professors Edwin Cohn, Kistiakowsky and J. Wyman at Harvard, and later in 1940 he came to the Radiation Laboratory at the University of California, where he was appointed research fellow.

Because of his thorough training in both physics and medicine, and due to his industry and brilliance, he soon made important contributions in the new field of artificial radioactivity. He was instrumental in putting on a practical basis the production of large quantities of radioactive yttrium, which proved to be very valuable as a gamma ray source for radiography of metallic flaws. He added much to our knowledge of calcium metabolism and in his work using radioactive strontium he showed that strontium acts physiologically in a manner similar to calcium in the animal body and because of its localization in bone is now being used experimentally in the treatment of neoplastic disease of bone. Mrs. Pecher assisted him in some of this work. At the time of his death, Dr. Pecher was serving with the Belgian Army in Canada, preparatory to embarkation to join the Belgian Army in England, and his death cut short the life of a young man who already had made lasting and worthwhile contributions to science.

JOHN H. LAWRENCE

CROCKER RADIATION LABORATORY,  
UNIVERSITY OF CALIFORNIA, BERKELEY

### DEATHS AND MEMORIALS

DR. KENNETH DANIEL BLACKFAN, since 1923 professor of pediatrics at Harvard University, died on November 29 at the age of fifty-eight years.

WALTER MATHEW DUNAGAN, associate professor of theoretical and applied mechanics at the Iowa State

College, died on November 24 at the age of forty-seven years.

DR. ROBERT RANDOLPH JONES, JR., assistant professor of surgery at Duke University, was shot and killed on November 18 in the private clinic at Duke Hospital at Durham, N. C. It is reported in the press that Dr. Jones had performed a plastic operation on the assassin about six months ago, but that the operation had been unsatisfactory to the patient and he had brooded over this until he became obsessed with the delusion that he had been mistreated. Dr. Jones was fifty-three years old.

FRIENDS at the University of Edinburgh of Dr. Stefan Kopeć, professor of biology in the University of Warsaw, have received word of his death from Polish sources. *The Ameryka-Echo*, a Polish newspaper, published in Chicago, carried last summer an announcement that he had been killed by the Germans. According to this announcement, Professor Kopeć was arrested with a hundred and fifty other citizens, every tenth of whom was executed. These were said to be in reprisal for the unsolved murder of the director of a Polish theater who had accepted service for German propaganda.

## SCIENTIFIC EVENTS

### ATKINS INSTITUTION OF THE ARNOLD ARBORETUM

ACCORDING to the *Journal* of the Arnold Arboretum, in the planting expansion program of the Atkins Institution at Soledad, Cienfuegos, Cuba, a number of palms were moved into the palm section, and several hundred shrubs and trees were transplanted into the newly acquired areas. In the additional area transferred to the garden in February, 1939, by the Soledad Sugar Company, the last cane crop has been harvested, so that all the land is now available for planting and development. Naturally with a restricted and modest income, as the planted areas are increased, a higher percentage of the income has to be used for maintenance purposes, so that the expansion of the plantings must of necessity be slow. It has been necessary to extend the nursery area, and Dr. Mangelsdorf's tropical American corn varieties being grown at Soledad have required the preparation of land for this purpose. A new entrance to the gardens was made at the corner of the recent addition below Casa Catalina, thus making the approach more direct. During the year 340 packets of seeds and 750 living plants were received and 433 packets of seeds, 46 living plants and 53 lots of cuttings were distributed. Mr. Sturrock's book on tropical fruits for southern Florida and Cuba and their uses was published through the cooperation of the Arnold Arboretum in 1940, the income from sales being impounded for the use of the Atkins Institution. About forty individuals enjoyed the hospitality of Harvard House for varying periods of time, the most that have taken advantage of the facilities available in any one year since the institution was organized. These included fourteen representatives of Harvard University working on various botanical and zoological problems. Other educational institutions represented include Wilson College, the University of Colorado, the University of Ohio, Skidmore College, the University of

Montreal, Colegio de la Salle and the University of Havana. Other institutions and organizations represented were the Fairchild Tropical Garden, the New York Botanical Garden, Montreal Botanical Garden, the Cleveland Museum of Natural History, the Ohio Division of Plant Industry, United Fruit Company and Cuban Agricultural Experiment Station. A group of four, under the leadership of Mr. and Mrs. Warren H. Corning, representing the Cleveland Museum of Natural History, made the Atkins Institution their headquarters for about a month while collecting natural history material for that institution. Among the Harvard staff members and students were Messrs. Gunkel, Salvin, Dahl, Howard, Hodge and Godfrey, who spent extended periods in the summer of 1940 working on various botanical problems, and Messrs. Dethier and Greenway, prosecuting zoological work. An extensive series of botanical specimens representing Cuban species was presented by José Carabia. The comprehensive collecting campaign initiated by Dahl, Howard, Godfrey and Hodge in the summer of 1940 will be continued during the summer of 1941, the objective being to secure the material on which a reasonably comprehensive flora of southern Santa Clara Province may be based.

### SYMPOSIA ON EQUINE ENCEPHALOMYELITIS AND MOSQUITO CONTROL

THE twelfth annual conference of the California Mosquito Control Association will be held at the University of California at Berkeley, on December 15 and 16.

Speakers and their subjects will be:

- I. *Opening Address*, President Earnest Campbell, superintendent, Contra Costa Mosquito Abatement District.
- II. *Symposium on Equine Encephalomyelitis*
  - A. *Introduction*, Professor W. B. Herms, head of

the Division of Entomology and Parasitology of the University of California.

- B. *The Relationship of Equine Encephalomyelitis and St. Louis Encephalitis to Man and Animals in California*, Beatrice Howitt, Hooper Foundation, University of California.
- C. *Newer Developments in Knowledge of Insect Hosts and Vectors*, William C. Reeves, Division of Entomology and Parasitology, University of California.
- D. *Host Animals of Virus Encephalitis*, Dr. W. McD. Hammon, Hooper Foundation, University of California.

Discussion by: Dr. W. T. Harrison, liaison officer, U. S. Public Health Service, 9th Corps Headquarters; Dr. Ellis D. Sox, coordinating officer, California State Department of Public Health.

### III. Symposium on Mosquito Control and National Defense

- A. *Introduction* by Dr. Bertram P. Brown, director, State Department of Public Health.
- B. *Military Mosquito Control in World War I*, Dr. S. B. Freeborn, professor of entomology and assistant dean of the College of Agriculture, University of California at Berkeley.
- C. *Federal Aid in Mosquito Control Work*, Dr. R. H. Creel, district director, U. S. Public Health Service.
- D. *Mosquito Breeding and Control in Vicinity of Military Zones*, R. F. Peters, state mosquito control officer.

At the evening banquet Dr. A. C. Reed, Division of Preventive Medicine, University of California Medical School, will speak on "Problems Involved in Control of Mosquito Borne Diseases under Tropical Conditions."

The second day will include a "Review of Literature on Mosquitoes for 1940-41" and a laboratory demonstration on identification of California mosquitoes by William C. Reeves, Division of Entomology and Parasitology, University of California. "Review of Recent Changes in Legislation Affecting Mosquito Control Operations," by Harold F. Gray, engineer and executive officer, Alameda County Mosquito Abatement District. "The Effect of Priorities and National Defense on Mosquito Control Operations," by Fred Hayes, superintendent, Dr. Morris Mosquito Abatement District, Bakersfield. The last item on the program will be an operators symposium on problems of power spraying, larvicides, mosquito fish, breeding in sewer farms, controlled reflooding and rice field control.

Representatives from over twenty-five mosquito abatement districts and from health departments and universities in California ordinarily attend the conference. In addition, invitations are sent to state uni-

versities, health departments and individuals in all the western states.

### AWARDS OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

The following awards were presented by the American Society of Mechanical Engineers at the annual dinner of the society on December 3:

Theodor von Kármán, director of the Guggenheim Laboratory of the California Institute of Technology, Pasadena, who is a consultant of the material division of the U. S. Army Air Corps, will receive the American Society of Chemical Engineers Medal for 1941. The citation is for "his brilliance as a teacher, his researches in elasticity and many fields of physics and mechanics, and his distinguished leadership in the fields of aerodynamics and aircraft design."

John C. Garand, of the Springfield Armory, Mass., will receive the Holley Medal, instituted in 1924 "to be bestowed for some great and unique act of genius of engineering nature, that has accomplished a great and timely public benefit." The citation is "for his invention and development of the semi-automatic rifle which bears his name and has been adopted by the United States Army, and is a distinct contribution to our National Defense."

The 1941 Worcester Reed Warner Medal, established to recognize outstanding contributions to permanent engineering literature, is awarded to Richard Vynne Southwell, professor of engineering science at the University of Oxford. The citation is "for his many distinguished services to engineering and science through papers and publications in many fields, including aeronautics, theory of structures, elasticity and hydrodynamics."

Roger Vernon Terry, assistant chief engineer of the Newport News Shipbuilding and Drydock Company, Newport News, Va., will receive the Melville Medal for his paper, "Development of the Automatic Adjustable-Blade-Type Propeller Turbine," presented at the 1940 annual meeting of the society.

Rollin Hosmer Norris, engineer in charge of the heat transfer section of the general engineering laboratory of the General Electric Company, Schenectady, is awarded the 1941 Pi Tau Sigma Award "for outstanding achievement in mechanical engineering, particularly in the heat transfer field." This award was established by the National Honorary Mechanical Engineering Fraternity to be presented for outstanding achievement within ten years after graduation from a mechanical engineering course in a recognized American college or university.

John T. Bettaliata, an engineer of the Allis-Chalmers Manufacturing Company, Milwaukee, will receive the 1941 Junior Award, presented for the best paper or thesis submitted by a junior member, for his paper, "The Combustion-Gas Turbine."

John J. Balun, a student engineer with the General Electric Company in Schenectady, N. Y., will receive the 1941 Charles T. Main Award for the best paper written by a student-member on the subject, "The Need and Pos-

sibilities of Participation by Engineers in Public Affairs."

G. Walker Gilmer, 3d, engineer with Pan American Airways-Africa, Ltd., on stress analysis and repair design on the aircraft ferried by the company to Africa under the defense program, will receive the 1940 Undergraduate Student Award of the society for his paper, "Center of Pressure Characteristics of a Marconix Yacht Sail."

### THE TWENTIETH ANNIVERSARY OF THE PSYCHOLOGICAL CORPORATION

A LUNCHEON and a panel program to mark the twentieth anniversary of the Psychological Corporation and to honor its founder, James McKeen Cattell, was held in the Hotel Roosevelt, New York, on November 28. At the luncheon Professor Walter R. Miles, of Yale University, presided, and addresses were made by Professor Edward L. Thorndike, of

Teachers College, Columbia University, and Dr. Paul S. Achilles, vice-president and managing director of the Psychological Corporation. The luncheon was attended by more than three hundred of those interested in psychology. Announcement was made of the establishment of grants in honor of Dr. Cattell to be made annually to graduate students to promote work in applied psychology.

Panel discussions, in which twenty-five psychologists took part, and their chairmen were as follows:

*Public Opinion and Consumer Surveys*, Dr. George H. Gallup, of the American Institute of Public Opinion.

*Industrial Psychology and Personnel*, Dr. Walter V. Bingham, chief psychologist, Personnel Procedures Section, the Adjutant General's Office.

*Psychology in Guidance and Counseling*, Dr. Walter R. Miles, professor of psychology, School of Medicine, Yale University.

## SCIENTIFIC NOTES AND NEWS

PROFESSOR HARLOW SHAPLEY, director of the Harvard College Observatory, has been awarded the Pius XI Prize for Astronomy of the Pontifical Academy of Science amounting to approximately \$2,500 at normal exchange. The announcement of the award was made by the president of the academy, the Rev. Agostino Gemelli, at the inauguration of the new academic year, which was attended by the Pope.

PROFESSOR FRED C. KOCH, Frank P. Hixon distinguished service professor emeritus at the University of Chicago, has been elected honorary foreign member of the National Academy of Medicine of Buenos Aires.

HARVARD UNIVERSITY has conferred the degree of doctor of laws on Dr. Percy R. Howe, Thomas Alexander Forsyth professor of dental science and director of the research laboratory of Forsyth Dental Infirmary in the Harvard Medical School.

IN honor of Dr. David D. Leib, who for twenty-five years has been professor of mathematics, registrar and director of admissions at Connecticut College, New London, the college hopes to raise \$100,000 for a scholarship fund.

PROFESSOR EDWARD J. KEEGAN, chairman of the department of biology of St. John's University, Brooklyn, has been elected president of the New York Chapter of the Society of American Bacteriologists.

DR. KATHARINE ELIZABETH McBRIDE, dean of Radcliffe College, Cambridge, Mass., A.B. and Ph.D. of Bryn Mawr College and formerly associate professor of education and philosophy there, has been elected

president of the college, to succeed Dr. Marion Edwards Park, who has been president since 1922.

DR. CLARENCE H. BEECHER, professor of medicine at the University of Vermont College of Medicine, has been appointed dean to succeed Dr. Hardy A. Kemp, who has become dean of the College of Medicine of the Ohio State University.

DR. GEORGE W. MUHLEMAN, who retired recently from Hamline University, has become visiting professor of chemistry at Alma College, Michigan.

DR. WILLIAM T. CLARK, associate professor of hygiene and public health at the School of Medicine of the University of Buffalo, has been appointed professor and head of the department, to succeed the late Dr. Walter S. Goodale, who had held the position for sixteen years prior to his death on October 8.

DR. RAFAEL E. PONTIS, director of the Government Laboratory of Phytopathology at Mendoza, Argentina, has become a member of the division of plant pathology of the College of Agriculture of the University of California.

DR. MILO HELLMAN, professor of dentistry at Columbia University and research associate in physical anthropology at the American Museum of Natural History, New York, has retired from active practice and will devote his time to consultation and research.

DR. WILLY PRAGER, formerly acting director of the Institute of Applied Mechanics of the University of Göttingen and, after having been "requested" to leave Germany in 1933, professor of applied mechanics at the University of Istanbul, has been appointed professor of mechanics at Brown University.

DR. FRANCIS PERRIN, professor of theoretical physics at the Sorbonne, Paris, has been appointed visiting professor of chemistry at Columbia University. He will conduct graduate seminars in theoretical physical chemistry. Dr. Perrin is the son of Professor Jean Perrin, who was visiting professor at Columbia University in 1913.

DR. WILLARD C. RAPPLEYE has been elected president of the Josiah Macy Jr. Foundation, to succeed the late Dr. Ludwig Kast, who died last August. Dr. Rappleye is dean and professor of medical economics at the College of Physicians and Surgeons, Columbia University, and a director of the New York Post-Graduate Medical School and Hospital.

DR. CAROLINE B. ZACHRY, director of research of the Progressive Education Association and of the Institute for the Study of Personality Development, New York, has been nominated for the post of director of the Bureau of Child Guidance of the New York City school system. She will receive, it is said, a salary of \$12,000.

WALTER R. G. BAKER, Chester H. Lang, David C. Prince, Elmer D. Spicer and Harry A. Winne have been elected vice-presidents of the General Electric Company, Schenectady, N. Y.

DR. B. H. WILLIER, Henry Walters professor of zoology and chairman of the department of biology at the Johns Hopkins University, has accepted the editorship of *The Quarterly Review of Biology*, beginning with Volume 17 (1942). The *Review* was founded by the late Raymond Pearl in 1926, and edited by him continuously until his death in 1940. In the interim the editorial work of the *Review* has been carried forward by Mrs. Pearl.

DR. ORLANDO PARK, Northwestern University, will succeed Dr. W. C. Allee as editor of the Section of General Animal Ecology of *Biological Abstracts*. The Section of Speciation will be conducted by Dr. Alfred Emerson, of the University of Chicago.

GORDON GORDON-TAYLOR, Surgeon Rear-Admiral to the British Royal Navy, has been visiting the United States. During the week of November 3 he attended the thirty-first Clinical Congress of the American College of Surgeons in Boston. During this session he received an honorary fellowship in the college and spoke concerning certain aspects of military and naval surgery. For the week from November 9 to 15 he was surgeon-in-chief *pro tempore* at the Peter Bent Brigham Hospital, Boston, and again spoke on military and naval surgery before the Harvard Medical Society.

It is announced by Dr. Franz Boas, professor emeritus of anthropology at Columbia University, that a protest against the imprisonment by the Ger-

mans in France of five French scientific men, all members of the Academy of Sciences, has been sent to Marshal Petain signed by a group of workers in science and education. Copies of the letter were sent to Gaston Henry-Haye, the French Ambassador to Washington, and to Secretary of State Cordell Hull. Those imprisoned are Dr. Emile Borel, director of the Institut Henri Poincaré and Institut des Hautes Etudes, a former Minister of the Navy under Poinlevé; Dr. Paul Langevin, formerly professor of physics at the Collège de France, president of the Solvay Council for Physics; Dr. Aimé Cotton, professor of physics; Charles Mauguin, professor of mineralogy and crystallography, and Dr. Louis Lapicque, professor of physiology at the Sorbonne, a member of the Academy of Medicine.

DR. HENRIK DAM, discoverer of vitamin K and associate professor at the Biological Institute of the University of Copenhagen, addressed the department of biological chemistry and the University of Cincinnati Chapter of Sigma Xi on "A Survey of the Present State of Knowledge on Vitamin K" on November 26.

PROFESSOR J. C. DRUMMOND, scientific adviser to the British Ministry of Food, is delivering a series of four lectures at the Royal Institution, London, on "Recent Advances in the Science of Nutrition and Their Significance in Wartime."

NOMINATIONS for membership in the American Society of Naturalists should be in the hands of the secretary, Dr. Alfred C. Kinsey, Indiana University, Bloomington, by December 10, if they are to be acted upon by the executive committee and the society at the forthcoming annual meetings at Dallas. All members of the society are entitled to make such nominations. The rules of the society provide that "the qualifications for membership should include a demonstration of continued research productiveness of high order in some branch of biological science, combined with a philosophical interest extending beyond a single research field."

THE autumn meeting of the American Society of Agricultural Engineers was held from December 1 to 3 at the Stevens Hotel, Chicago, under the presidency of Geo. W. Kable.

THE Soil Science Society of America held its annual meeting in Washington, D. C., from November 12 to 14, at which nearly a hundred scientific papers were presented. There was a symposium on "Calcium in the Soil," discussed from a physico-chemical point of view by Dr. Richard Bradfield, of Cornell University; from a biological point of view by Dr. W. H. Pierre, of the Iowa State College, and from the geographic point of view by Dr. Hans Jenny, of the

University of California. At the annual banquet Dr. Bushrod W. Allin, of the U. S. Department of Agriculture, outlined the vital rôle of soil investigators in agricultural planning, especially in the critical years to come, if production is to be adjusted to war needs and subsequent adjustments to peace time are to be made without waste and suffering. Officers were elected as follows: Dr. Horace J. Harper, professor of soils in Oklahoma State Agricultural and Mechanical College, became president for 1942, and Dr. Firman E. Bear, professor of soils at Rutgers University, was elected secretary. Dr. Charles E. Kellogg, chief of the Division of Soil Survey in the U. S. Department of Agriculture, is the retiring president. The next annual meeting is to be held in St. Louis in November, 1942.

AN academy conference at Dallas, Texas, has been scheduled to follow immediately the council session on Monday afternoon, December 29. The session will convene in Parlor E, Hotel Adolphus. The council session is set for 2:15, but if the usual practice is followed this session will be adjourned early in order to give the conference ample time for the reading of papers and discussion. A complimentary dinner will be held at 6:30 P.M. Two papers will be presented. The first, "A Progress Report on Research Grants," will be presented by Dr. E. C. Faust, of the New Orleans Academy. The second, entitled "The Development of a Collegiate Division of the Texas Academy of Science," will be presented by Dr. J. C. Godbey.

A CONFERENCE on "The Ultracentrifuge" was held on November 14 and 15, under the auspices of the Section of Physics and Chemistry of the New York Academy of Sciences. Papers were presented by J. W. Beams, University of Virginia; J. W. Williams, University of Wisconsin; W. J. Archibald, National Research Council, Canada; Alexandre Rothen and Duncan A. MacInnes, both of the Rockefeller Institute, the latter acting as conference chairman.

THE eighth annual congress of the American Association for the Advancement of Oral Diagnosis was held at the New York Academy of Medicine on

November 13 and 14. Speakers at the meeting included Dr. J. L. T. Appleton, Jr., dean of the Dental School of the University of Pennsylvania, and Dr. Kurt H. Thoma, head of the new school of Oral Medicine at Harvard University.

A SYMPOSIUM on "Recent Advances in the Chemistry of the Nonmetals" will be held in Columbus, Ohio, on December 29, 30 and 31, under the sponsorship of the Division of Physical and Inorganic Chemistry of the American Chemical Society.

THE University of Michigan will be host to chemists who attend the ninth National Organic Chemistry Symposium from December 29 to 31. Dr. Moses Gomberg, University of Michigan, and Dr. William Lloyd Evans, of the Ohio State University, president of the American Chemical Society, will open the symposium, which will be addressed by Homer Adkins, W. E. Bachmann, Leslie G. S. Booker, Nathan L. Drake, Karl Folkers, C. R. Hauser, Morris S. Kharasch, S. M. McElvain, C. S. Marvel, Ralph L. Shriner, Roger J. Williams and Frank C. Whitmore. Inquiries should be addressed to Dr. Arthur C. Cope, Department of Chemistry, Columbia University, New York, N. Y.

DR. ERIC S. PROSKAUER, of Interscience Publishers, Inc., calls attention to the misspelling of names of German physicists in an article printed under "Special Correspondence" in the issue of SCIENCE for November 21. This correspondence, which was entitled "Physics in Pre-Nazi Germany," should have been entitled "Physics in Nazi Germany." It was sent by a Russian correspondent through *Tass*. The editor of SCIENCE, in reading the manuscript, was more concerned as to whether it should be printed than with the spelling of names, in regard to which the proof-readers of SCIENCE are usually very accurate. As a matter of fact, the editor was absent from his office attending the meeting of the American Philosophical Society in Philadelphia when the proof was received. Such names as Klausius for Clausius appear to be due to a transcription of German names into Russian and retranscription into English. The names are obvious, but the errors in spelling are regrettable.

## DISCUSSION

### NICOTIANA RUSTICA IN NEW MEXICO

PROFESSOR LESLIE A. WHITE reports<sup>1</sup> finding *Nicotiana rustica* cultivated in 1934 by the Tamaya Pueblo Indians near Bernalillo, New Mexico, and states:

This discovery is of interest for two reasons: (1) There is very little evidence indeed to indicate that tobacco of

any kind has ever been cultivated by the Pueblo Indians of the Southwest; and (2) it is surprising to find this particular species of *Nicotiana* in this region. . . .

The presence of this species under cultivation at Tamaya to-day remains to be explained. It may have been introduced within the past 50 years or so from some eastern Indian reservation, to be sure. But the possibility that it may be a relic of the original diffusion from Mexico can not be entirely dismissed at this time.

<sup>1</sup> Leslie A. White, SCIENCE, Vol. 94, p. 64.

The suggestion is offered that the presence of *Nicotiana rustica* in the vicinity of Bernalillo in 1934 and 1936 as reported by Professor White may have been due to its rather recent introduction by the white man. In 1925 a commercial development was undertaken for the production of *Nicotiana rustica* for nicotine in the upper Rio Grande Valley. In 1927 several hundred growers were reported engaged in the production of the species on plots ranging from fractions of an acre to 8 or 10 acres. Most of the growers were located north of Albuquerque, and more than 200 acres were reported grown in 1927. This project was developed and managed by Mr. R. G. Mewborne, of the Consumers Tobacco Company of Albuquerque, New Mexico, and continued through 1929.<sup>2</sup>

Between 1926 and 1929 the writer was also interested in the experimental production of nicotine in the Rio Grande Valley and had plots grown near Albuquerque, Las Lunas and Las Cruces, New Mexico. Several varieties of *Nicotiana rustica* were grown, although *brazilia* was the one used in the general commercial production.

During the period of 1925 to 1929 *rustica* plants and, no doubt, seeds as well, were easily available in the upper Rio Grande Valley, and it is suggested that the presence of the *rustica* plants near Bernalillo might well be traced to the wide-spread development which was attempted in that area between 1925 and 1929.

E. G. BEINHART

U. S. DEPARTMENT OF AGRICULTURE

#### A NOTE ON THE DETERMINATION OF THIAMINE BY THE YEAST FERMENTATION METHOD

IN a recent issue of *SCIENCE*<sup>1</sup> a paper on thiamine determination contained the following paragraph:

Bunzell's difficulties recall the experience of Smythe, who, observing a remarkable stimulation of fermentation due to an extract of bull testicle, finally isolated ammonium chloride as the active factor. Smythe made the additional mistake of obtaining his yeast from the small cakes sold in grocery stores. Such yeast is too rich in thiamin to show any stimulation of fermentation when thiamin is added to the medium.

This curious paragraph contains both misstatements of fact and false implications so a correction is considered necessary. My paper<sup>2</sup> was not concerned with the determination of thiamin. It was concerned with finding out why the extracts in question stimulated fermentation when thiamin did not stimulate. Conse-

quently, it was neither a mistake nor an additional mistake to use a yeast rich in thiamin. It clearly would have been a mistake to use a yeast in which thiamin was not present in excess.

Although ammonium chloride was isolated and shown to stimulate fermentation under certain conditions by as much as 100 per cent., the activity of the extracts was not found to be due solely or even chiefly to the ammonium chloride contained in them. From the chemical behavior of the extracts it was suggested that the activity was due to amino acid amides—free and combined. In accord with this suggestion glutamine and asparagine were shown actively to stimulate fermentation. d-Arginine also was found to be an active stimulator. As stated in the paper<sup>2</sup> an accelerating effect of ammonium salts on fermentation had been established as long ago as 1926,<sup>3</sup> but an accelerating effect (as distinct from a growth effect) for the other compounds mentioned had not been established as far as I am aware.

The above results were presented at a symposium held at Gibson Island in August, 1938,<sup>4</sup> and appeared in the February, 1939, issue of *Enzymologia*.<sup>2</sup> It is interesting to note that the first published account of the thiamin fermentation method to properly define the principle and limitations of the analysis was sent to press in May, 1939.<sup>5</sup> The fact that asparagine and arginine (along with some other less active amino acid compounds) stimulate fermentation was published by the same authors as new information in September, 1939,<sup>6</sup> and is cited by them in their recent paper as showing that various amino acids, etc., have an effect equivalent to ammonium ions.

C. V. SMYTHE

UNIVERSITY OF PITTSBURGH

#### EXCEPTIONAL BURIAL IN CALIFORNIA

DURING excavations carried on by the Santa Barbara Museum of Natural History, a unique burial was uncovered on Mescalitan Island, an old Indian site, near Santa Barbara, California. This find is outstanding among burials of the west coast.

The skeleton of a small adult, age 30-35, lay in the conventional face-down flexed position of the Canaliño (Chumash), but upon the highly inlaid scapula of a whale. The scapula had served as a slab, or a coffin without top or sides, and measured 46½ inches transversely and 30 inches proximo-distally. The spine had been planed off with stone tools, forming a perfectly flat surface upon which the skeleton lay. Around the superior border a narrow groove was cut and in this,

<sup>2</sup> R. G. Mewborne, "Tobacco as a New Industry for New Mexico," New Mexico State Planning Board, Santa Fe, 1936.

<sup>1</sup> A. S. Schultz, L. Atkin and C. N. Frey, *SCIENCE*, 94: 312, 1941.

<sup>3</sup> C. V. Smythe, *Enzymologia*, 6: 9, 1939.

<sup>4</sup> H. Zeller, *Biochem. Zeits.*, 175: 135, 1926.

<sup>5</sup> *SCIENCE*, 88: 9, 1938.

<sup>6</sup> L. Atkin, A. S. Schultz and C. N. Frey, *Jour. Biol. Chem.*, 129: 471, 1939.

<sup>7</sup> A. S. Schultz, L. Atkin and C. N. Frey, *Cereal Chem.*, 16: 648, 1939.

inlaid with asphalt, is a row of *Olivella* shell disks of the type commonly worn as beads. These shells are placed about five to the inch, with a total of 305 shells, part of which were covered with the skeleton, there being 170 beads visible.

Two abalone shell disks about three inches in diameter were on each side of the skeleton, countersunk and secured with asphalt, together with calluses of the limpet *Megathura*. The abalone disks are surrounded by a row of *Olivella* disks, as are some of the limpets. The design is not symmetrical, although at casual glance it appears so.

The skull lay face down, hands folded under the skeleton. Across the neck was a string of large steatite tubular beads, each bead carved or inlaid and about three inches long, mixed with strings of *Olivella* shell disk beads. A short strand was upon each knee and another long strand lay along the spine.

Beside the skull, on the left, was a small stone bowl lying on its side—the mouth of the bowl pressed against the side of the skull. This bowl is about four inches across by two and three-quarters deep.

Beyond the skull, many of the *Olivella* shell disk beads were found, apparently having been thrown into the grave by the handful. Fragments of a turtle shell rattle were also recovered.

This burial, which was taken out intact, is being displayed in the Santa Barbara Museum of Natural History as an exhibition just as it was uncovered, com-

plete with a reproduction of the grave from which it came, and with painted background of the location.

The cemetery from which this specimen was secured represents the latter part of the earliest phase of the Canaliño culture of this area. A complete report of the excavation on Mescalitan Island is in preparation.

PHIL C. ORR

SANTA BARBARA MUSEUM OF  
NATURAL HISTORY

### HIGGINS VERSUS HIGBEE

IN SCIENCE of July 26, 1940, p. 80, a short notice was published by Dr. Edna Higbee, of the University of Pittsburgh, on the results of injection of colchicine into hen's eggs. At the Philadelphia meeting of the American Society of Zoologists, Section of Endocrinology, December 30, 1940, Dr. Higbee (introduced by R. T. Hance) reported on her work with colchicine. Philadelphia newspapers and *The New York Times* of the following day selected her paper for their report on the meetings. Science News Service also included her paper in its report to the newspapers of the country. Unfortunately, an error slipped in, that changed Dr. Higbee's name to Higgins. And this error was perpetuated: in *Science News Letter* of January 25, it is Higgins, and so it is in the *Science News Supplement* to SCIENCE of February 14.

E. ALFRED WOLF

UNIVERSITY OF PITTSBURGH

## QUOTATIONS

### GERMAN PERSECUTIONS IN POLAND

We have received from the Association of Polish Professors and Lecturers in Great Britain (Polish Research Centre, 32 Chesham Place, London, S.W.1) a letter protesting against the second series of persecutions by the Germans of Polish men of science and others since the war began. The fury of the first German attack on Polish science and culture was raging in November, 1939, when 180 professors and assistants of the oldest Polish university, that of Cracow, were deported "as criminals" to the concentration camp at Oranienburg. Now we are witnessing the second German attack on Polish science, carried out in the newly occupied territories and aiming at completing the destruction. On occupying Lwow the Germans executed Professor C. Bartel, professor of mathematics in the Lwow Technical College (see *Nature* of October 4, p. 402); they also arrested sixty other professors, among them a number of elderly men. The German persecutions are an integral part of the methodical campaign aiming at the total destruction of Polish culture. All the Polish universities, technical and agricultural colleges, commercial

academies, all research institutes, all scientific societies, including the Polish Academy of Sciences, have been closed by the Germans. The same fate has befallen all secondary schools. The scientific apparatus and the equipment of laboratories have been transported to the Reich. The Polish museums were and still are being looted. Publication of books and periodicals as well as of independent newspapers has been suspended. Monuments which showed the artistic culture of the nation have been pulled down and destroyed.

All the professors of the University of Poznan have been expelled, deprived of all their personal possessions and left starving. Some of them, headed by Professor Bronislaw Dembinski, honorary professor of history, have died as a result of the dreadful conditions of life to which they were exposed. Eighteen professors of the University of Cracow, among them the most prominent representatives of Polish science, have died as a result of tortures suffered in the concentration camp of Oranienburg. The professors of the Catholic University of Lublin were kept in prison for some months and some of them are still in con-

centration camps. Recently a number of Warsaw professors perished as victims of undeserved persecution. "To this black record of German persecutions a new page has been added—the persecutions of Lwow. Executions and concentration camps for Polish men of science—that is what the German

'crusade in the defence of civilization' has brought with it." In view of these new German crimes which bear full witness to a total degeneration of Hitlerite Germany, we feel sure that men of science in all free countries will wish to join in this solemn protest by Polish savants in Great Britain.—*Nature*.

## SCIENTIFIC BOOKS

### THE ELECTRIC SPARK

*The Mechanism of the Electric Spark.* By LEONARD B. LOEB and JOHN M. MEEK. xiii+188 pp. 43 figures. Stanford University Press. \$3.50.

THE book is divided into three chapters, dealing respectively with the Townsend theory of the spark discharge, the streamer theory and the calculation of breakdowns in air. The first chapter develops the background necessary to a complete understanding of the problem, the second describes the point of view which the authors have been especially instrumental in developing, and the final section may be regarded as a discussion of certain practical applications.

The authors begin with a critique of the Townsend theory of the progress of an electrical discharge between two surfaces, and examine the regions of validity of this theory. They review the pertinent considerations and show at what points the observed facts depart from simple theory. They conclude that the mechanism envisioned by Townsend, which is known to be quite successful in explaining phenomena at low pressures and small distances, as for example in certain particular cases in Geiger counter action, do not apply in air at high pressures and big gap-lengths. Time-lags are discussed. The amount and nature of the departures of observation from theory suggests criteria to which a more comprehensive picture of the mechanism must conform.

In the next section, the authors develop the picture of the formation of streamers in a discharge. They point out the sources of error in past experiments, such as lack of stability control of potential sources, inaccuracies in voltage-measurement and of gas-purities. The properties of streamers are explored, as are the corollary effects due to overvoltage, branching and time-lags. The ion densities necessary for streamer propagation are computed and photo-effects are discussed. Finally the full development of a lightning stroke is described, and it is shown how the various considerations developed will explain the observed phenomena.

The final chapter deals with the applications of the theory to the actual calculation of breakdowns in gaps. Many examples are given, and the comparison of theory and observation is presented. The effect of pertinent factors such as air-density is discussed. The

case of the breakdown in coaxial cylinders is considered at some length, this case being of practical importance in electrical power transmission problems; and finally, corona discharge is briefly considered.

On the whole the book contains a useful summary and digest of discharge theory, and should be of especial value to those working with the various aspects of spark discharges. Possibly owing to the incidence of the present emergency on all scientific work, the book shows some signs of haste in preparation, as a number of amusing statements have appeared which the authors would undoubtedly have altered had time been available. For example, the high speed ions are cited on page 39 as traveling at the incredible speed of  $1.3 \times 10^{-8}$  cms/sec; a sentence on page 56 ends with a reference to "... positive ions of a questionable sort," and the name of the firm by which the junior author was employed was spelled in the title page as the "Metropolitan Vicars Company." On the other hand, there is no doubt that the authors have done a good piece of work, and give a useful presentation of a subject on which they may be considered authorities.

SERGE A. KORFF

BAETOL RESEARCH FOUNDATION,  
SWARTHMORE, PA.

### METEOROLOGY

*Dynamic Meteorology.* By BERNHARD HAURWITZ. 365 pp. New York: McGraw-Hill. 1941. \$4.00.

THIS book appears at an opportune moment. In recent years the science of meteorology has suddenly moved into the limelight from a state of comparative obscurity. The demands of civilian and military aviation and of a vastly expanded maritime activity have led ever increasing public circles to a realization of the significance of accurate weather forecasts and of the influence of the atmosphere upon innumerable activities of man.

The book gives an account of the analytical tools used by the meteorologist. Apart from offering to the professional a number of methods and formulae presented for the first time in a text-book, it should be of value to anybody who in the course of his work comes in contact with phenomena in the atmosphere. Although the presentation is essentially mathematical,

the formulae are always reduced to their simplest form and are derived in the clearest, most direct and easily understandable manner. Cross-references and similar complexities that mar most scientific text-books are here reduced to an absolute minimum. The book does not presuppose any particular knowledge of meteorology, but the non-meteorological reader will do well to use the book parallel with one of the numerous non-mathematical accounts of meteorology in order to keep in sight the practical significance of the methods discussed. Otherwise the student will not need more than a general knowledge of college physics and of calculus. Numerous footnotes throughout the book contain carefully selected references to original papers in dynamic meteorology and offer a valuable guide to the reader interested in ampler study in this field.

The first four chapters deal with the application of thermodynamics to the atmosphere, the second law of thermodynamics as far as needed being derived in the book itself. The fifth chapter treats briefly of the effects of solar and terrestrial radiation upon the air.

The sixth to ninth chapters deal with the application of the hydrodynamic equations to the simplest cases of atmospheric motions, especially stationary flow. The fundamental equations are again derived in the book itself in a simple manner. The tenth and eleventh chapters contain an account of the theory of turbulence as applied to meteorology; here the simplicity of presentation without loss of comprehensiveness is particularly gratifying. The twelfth to fifteenth chapters deal with a variety of topics, such as the energy of atmospheric motions, the general circulation of the atmosphere, the perturbation theory of atmospheric motions and finally we get a glimpse of the ideas underlying the dynamical theory of fronts and cyclones where there is still much room for controversy and further research. The book brings the student to the threshold of all the important current problems in modern meteorology.

W. M. ELSASSER

BLUE HILL METEOROLOGICAL OBSERVATORY  
OF HARVARD UNIVERSITY

## SPECIAL ARTICLES

### THE EFFECT OF INCREASED PANTOTHENIC ACID IN THE EGG ON THE DEVELOPMENT OF THE CHICK EMBRYO<sup>1</sup>

MODERATE variations in the intake of the "B vitamins" appear to be without effect on free-living animals. The ingestion of two or more times the daily requirement by an animal not suffering from a deficiency has not been observed to be associated with any special changes of a physiological nature.

Few if any attempts have been made to investigate the effects of a varied level of these vitamins during embryological development, even though the embryo with its special type of metabolism might be expected to respond in a different manner than has been the experience with post-embryological animals.

In the present investigation the pantothenic acid available to the chick embryo was increased in two ways, by direct injection into the egg before incubation and by supplementing the diet of a flock of hens with three times the daily requirement of this vitamin. For injection 100-150 micrograms or about 10 to 15 per cent. of the total pantothenic acid normally present in the egg was dissolved in sterile egg white and injected in this form into the experimental eggs. The control eggs received the same quantity of pure egg white.

The eggs from the hens on the supplemented diet were incubated at different periods after the special

diet had been initiated. In this manner eggs can be obtained with varying levels of pantothenic acid up to more than twice the normal concentration.<sup>2</sup> The hens from which the eggs were taken consisted of pure-blooded white Leghorns whose regular diet was well balanced and apparently adequate in all respects.

After 12 days' incubation the control and experi-

TABLE 1  
THE EFFECT OF RAISING THE LEVEL OF PANTOTHENIC ACID IN THE EGG 10 TO 20 PER CENT BY INJECTION

Experiment	Number of embryos	Viability control = 100	Hemoglobin control = 100	Relative brain weight control = 100	Relative heart weight control = 100
Control .....	42				
Pantothenic acid .....	42		108	107	93
THE EFFECT OF RAISING THE PANTOTHENIC ACID LEVEL OF EGGS BY PLACING HENS ON SUPPLEMENTED DIET					
Group 1—Control .....	13				
Group 1—Pantothenic acid* ..	30	115	116	106	100
Group 2—Control .....	13				
Group 2—Pantothenic acid ..	31	123	113	103	82
Group 3—Control .....	8				
Group 3—Pantothenic acid ..	24	130	108	96	83
1 to 3 days after discontinuing supplementary diet					
Group 4—Control .....	13				
Group 4—Pantothenic acid ..	27	109	110	90	85

\* Group 1, eggs collected 4-6 days after initiating supplemented diet; group 2, 7-9 days; group 3, 11-14 days; group 4, 1-3 days after discontinuing supplemented diet.

<sup>2</sup> Snell, Aline, Couch and Pearson, *Jour. Nutrition*, 21: 201, 1941.

<sup>1</sup> This investigation was supported by a grant from the Clayton Foundation.

TABLE 2

THE EFFECT OF AN INCREASE OF PANTOTHENIC ACID IN THE EGG ON THE VITAMIN LEVEL OF THE LIVER, BRAIN AND HEART OF THE DAY-OLD CHICK

Vitamin level of eggs raised by supplementing diet of hens									
Vitamin	Exper. liver γ/gm.*	Control liver γ/gm.	Exper. liver when con- trol = 100	Exper. brain γ/gm.	Control brain γ/gm.	Exper. brain when con- trol = 100	Exper. heart γ/gm.	Control heart γ/gm.	Exper. heart when con- trol = 100
Pantothenic acid . . .	98.0	99.0	99.0	270.0	250.0	108.0	224.0	186.0	120
Inositol . . . . .	2600.0	2200.0	118.0	8800.0	13000.0	67.5	2700.0	2400.0	113
Nicotinic acid . . . .	260.0	410.0	63.5	200.0	230.0	87.0	262.0	246.0	107
Riboflavin . . . . .	40.0	51.0	78.5	6.3	6.9	91.2	32.0	34.0	94
"Folic acid" . . . . .	99.0	180.0	55.0	5.0	7.5	66.7	6.6	6.0	110
Thiamin . . . . .	5.2	5.7	91.0	2.5	5.3	47.0	2.8	2.9	97
Pyridoxin . . . . .	1.4	2.4	59.2	2.5	1.3	102.0	.98	.77	127
Biotin . . . . .	.50	.39	128.0	.028	.038	74.0	.078	.075	104

\* γ/gram dry weight.

mental embryos were examined for blood hemoglobin concentration and relative size of the heart and brain. Data on the effect of the varied pantothenic acid level in the egg on hatchability were also obtained.

Six control and six experimental eggs from the group with the highest level of pantothenic acid were allowed to hatch and the liver, heart and brain of these chicks were assayed for several of the "B vitamins."

It is evident from Table 1 that there was a definite tendency for increased pantothenic acid in the egg to be associated with an increased hemoglobin concentration of the blood in the 12-day chick embryo. The effect on the relative brain and heart size depended upon the concentration of pantothenic acid present in the egg. A comparatively low concentration tended to be associated with a larger than normal brain, while both heart and brain were depressed in relative size in the embryos from the eggs with higher levels of pantothenic acid.

Embryo survival was better in every group of the eggs from the hens on the supplemented diet, indicating that a relatively high level of pantothenic acid in the egg is associated with improved hatchability.

The results given in Table 2 show that concomitant with the changes in brain and heart size there was also some shift in the balance and level of the eight vitamins in the tissues for which assays were made. This was especially true for the liver and the brain.

Work in progress indicates that some other members of the "B complex" modify the chick development when their level in the egg is raised to a moderate degree—which tends to confirm the results reported here for pantothenic acid.

It appears that during early embryological development, the chick embryo is highly responsive to a vitamin imbalance created by a moderate increase in the level of one of these food elements. Apparently the embryo is dependent on this vitamin balance even for

such fundamental characteristics as blood hemoglobin concentration and brain and heart size.

We wish to express our grateful appreciation to Dr. R. J. Williams for his interest and encouragement in this research.

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### THE PHENOMENON OF THIXOTROPY IN HEMOPHILIC AND HEPARINIZED BLOOD<sup>1</sup>

IN 1923 Szegvari and Schalek<sup>2</sup> observed a property of gels with hydrous ferric oxide for which the term "thixotropy" was suggested by Péterfi in 1927.<sup>3</sup> Ever since it has often been observed that an apparently solidified gel or a very viscous colloid can be liquefied by shaking or other mechanical agitation and upon standing again becomes a gel. This process, in which the time factor becomes apparent, can be repeated and is dependent upon temperature. Previous to this observation in Freundlich's laboratory<sup>2, 4</sup> Chambers<sup>5</sup> had observed in 1921 that frequently protoplasm becomes fluid by stirring with the micro-manipulator needle, and after some time becomes gelatinous again when permitted to stand. It is of great interest and it should be recognized that the phenomenon of thixotropy was described for the first time in 1910 by Howell<sup>6</sup> in studies of the conversion of fibrinogen to fibrin by the addition of thrombin in various amounts. He referred to observations on a similar process in horse's plasma at an earlier time.<sup>7</sup> Minot and Lee<sup>8</sup> observed this

<sup>1</sup> Aided by a grant from the Dazian Foundation for Medical Research.

<sup>2</sup> A. Szegvari and E. Schalek, *Kolloid-Z.*, 32: 318, 1923; 33: 326, 1923.

<sup>3</sup> T. Péterfi, *Arch. f. Entwicklungsmech. d. Organ.*, 112: 660, 1927.

<sup>4</sup> H. Freundlich, *Kolloid-Z.*, 46: 289, 1928.

<sup>5</sup> R. Chambers, *Proc. Soc. Exp. Biol. and Med.*, 19: 87, 1921.

<sup>6</sup> W. H. Howell, *Am. Jour. Physiol.*, 26: 453, 1910.

phenomenon with blood coagula of hemophiliacs and called it "reclotting phenomenon." There is only occasional reference made to it in the literature on hemophilia and it has not been especially studied by any one.<sup>9</sup>

Minot and Lee, who never wrote further on this phenomenon, at least in the direct sense,<sup>10</sup> described thixotropy as follows: "If, after the hemophilic blood had apparently clotted firmly, the clot was loosened and removed from the fluid, the fluid would clot and would do so sometimes almost at once, often in three to five minutes and sometimes not for ten to thirty minutes or more. Again on separating the clot, but not removing it from the serum, this reclotting phenomenon occurred and might be repeated from three to six times. The reclotting would occur no matter whether the clot was loosened a few minutes or a few hours after it had appeared solid. If one waited hours rather than minutes after the clot had formed, one usually obtained the reclotting phenomenon fewer times." Since we<sup>11</sup> succeeded in producing experimentally a hemophilia-like condition in mice by injections of excessive doses of purified heparin, it was of interest to investigate if thixotropy would occur with coagula of blood heparinized *in vitro* and *in vivo*.

Blood was obtained from the antecubital vein of humans and the femoral and jugular veins and the femoral artery of dogs. Heparin of the Connaught Laboratories, University of Toronto, 110 units per milligram, was used in doses between 0.1 and 2.0 units in physiological saline. All experiments were done at room temperature. 0.02 cc of the heparin solutions were placed into clean test-tubes and 1 cc of blood was added to each tube. In intervals between 30 seconds and 1 hour after the clot had formed it was disturbed by shaking or stirring and the time was measured until the clot formed again. For controls, blood was added to 0.02 cc of physiological saline. Blood coagula were tested from 44 dogs and 6 humans. Thixotropy always occurred with blood which was mixed with heparin, whereas the phenomenon never occurred in the controls. In samples containing 0.4 to 0.5 units, thixotropy occurred two to four times within 1 hour following the coagulation time of the blood. The phenomenon, if reproducible, occurred after a longer interval of time than previous to it after the second successive reclotting. Blood from 12 dogs drawn 26 to 50 minutes following intra-

venous injection of 200 units of heparin per kilogram weight was tested for its thixotropic property. In all cases thixotropy occurred two to seven times.

The observations of Minot and Lee could be repeatedly and fully verified with blood coagula of two hemophiliacs. The phenomenon was likewise observed with hemophilic plasma which was prepared after centrifuging hemophilic blood at 3,000 r.p.m. for 15 minutes. After the plasma had coagulated, the gel was loosened by a glass rod upon which it retracted rather suddenly and the formed fibrin was removed. From one or several minutes the gel formed again and the process of thixotropy could be repeated; in one case for five, and in the other for eight times. Plasma which was obtained from three of the heparinized dogs showed similar results, although it occurred only for two to three times.

The occurrence and frequency of thixotropy with heparinized blood or plasma is dependent upon the amount of heparin, the coagulation time and the length of time following the coagulation time and the reclotting, after which the gel is liquefied by mechanical agitation. The results indicate that the fibrinogen is progressively but slowly, at times over a period of hours, converted into fibrin in both the heparinized and the hemophilic conditions. This process may occur as long as there is either thrombin forming or until the amount of fibrinogen is exhausted due to its conversion. Studies of the mechanism involved in the production of thixotropy with blood coagula are being done. We are also determining whether the same mechanism is responsible for the phenomenon with both the hemophilic and heparinized coagula.

"Thixotropy" may be considered as a general term describing a physical system going for several times from semisolid to liquid state on mechanical agitation. It must be taken for certain that protoplasm with definite fibrillar elements actually exists according to Jordan.<sup>12</sup> That these protoplasmatic structures may be similar to the fibrin needle network of plasma gels is suggested at this time; however, the degree of similarity can only be taken into account by future work. Since a more exact classification of thixotropic phenomena does not exist at present the use of this term seems to be justified. The inclusion of the "reclotting phenomenon" with miscellaneous thixotropic systems should stimulate interest and ultimately lead to a better understanding of the thixotropy in blood plasma.

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<sup>9</sup> Professor Howell states in a personal communication that this work was done as early as 1892.

<sup>10</sup> G. R. Minot and R. I. Lee, *Archiv. Int. Med.*, 18: 474, 1916.

<sup>11</sup> W. H. Howell, personal communication, 1941.

<sup>12</sup> G. R. Minot, personal communication, 1941.

<sup>13</sup> A. L. Copley and J. J. Lalieh, *Am. Jour. Physiol.*, in press.

<sup>12</sup> H. J. Jordan in "First Report on Viscosity and Plasticity," Amsterdam and New York, Nordemann Publishing Company, 1939.

### THE EFFECT OF PYRIDOXINE ON THE URINARY EXCRETION OF A NEW FLUORESCENT SUBSTANCE<sup>1</sup>

RECENT reports<sup>2, 3</sup> have indicated that there are two fluorescent substances in the urines of normal individuals that are related to the level of nutrition of nicotinic acid. These have been named  $F_1$  and  $F_2$ . The latter is absent in the urines of pellagrins, but readily appears after adequate nicotinic acid therapy. While investigating the possible correlation of this phenomena with the anti-pellagra and anti-black-tongue activities of nicotinic acid and related pyridine derivatives, the present authors observed a marked increase of fluorescence in the  $F_1$  fraction following the ingestion of pyridoxine hydrochloride by normal and pellagrous patients. A dose of 100 mg of this vitamin is followed by a four- to ten-fold increase of a bluish-purple fluorescence during the first four-hour period as compared to the preceding control period. The average values of fluorescence in Najjar-Wood units for the control and test periods are 4 and 32,

respectively. The urinary substance responsible for the increased fluorescence resembles  $F_1$  in its adsorption on permutit ("Decalso"), elution with 25 per cent. potassium chloride solution and extraction from the eluate with isobutanol, but differs, however, from  $F_1$  in that it is extracted from only the untreated eluate. *In vitro* experiments with pyridoxine either alone or incubated for four hours with urine at pH 5.0 failed to demonstrate the presence of the unknown substance. We believe, therefore, that this unknown urinary constituent is a new entity and perhaps of significance in the intermediary metabolism of pyridoxine. Until its relationship to  $F_1$  and  $F_2$  is known, we hesitate to propose a name for its description. The details of studies, now in progress, on its physical and chemical nature will be reported elsewhere.

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## SCIENTIFIC APPARATUS AND LABORATORY METHODS

### A NEW TECHNIC FOR STAINING VAGINAL SMEARS: III, A SINGLE DIFFERENTIAL STAIN

Two previous communications to this journal<sup>1, 2</sup> have described modifications of the Masson trichrome stain, adapting it to the staining of vaginal smears. Among the advantages of this technic for the interpretation of the vaginal smear are its specificity for the cornified elements and the addition of a sequence of color changes to the cytological alterations which follow the endogenous elaboration, or the administration, of the reproductive hormones. Although this staining method is simple and rapid, the number of solutions required renders it somewhat cumbersome for general clinical use. A single differential stain would be more likely to encourage the wider use of the vaginal smear as a diagnostic index and as a guide for the therapeutic use of the reproductive hormones.

The purpose of this note is to describe a single differential staining solution, based on the technic previously developed and retaining its most useful features. In it are incorporated all the components of the original staining method with the exception of hematoxylin. It provides a sharp differentiation

between cornified and non-cornified elements. The former stain a brilliant orange-red; the latter take on a green stain which is deeper in the younger cells, and paler in those more advanced. The staining is delicate and reveals cytoplasmic and nuclear details very clearly. Other constituents, such as leucocytes, erythrocytes, bacteria and spermatozoa, are satisfactorily differentiated.

This composition of the Single Differential Stain (S3) is as follows:

ethyl alcohol (50 per cent.)	100 cc
Biebrich Scarlet (water sol.)	0.5 gms
Orange G	0.25 "
Fast Green FCF	0.075 "
phosphotungstic acid c.p.	0.5 "
phosphomolybdic acid c.p.	0.5 "
glacial acetic acid	1.0 cc

All the dyes are domestic and can be obtained from the National Aniline and Chemical Company. The solution should not be used until all the ingredients have dissolved completely.

The vaginal smears are prepared and stained as follows:

1. Aspirate the vaginal secretion by means of a dry pipette with rubber bulb attached, and expel onto a glass slide.
2. Fix, while wet, in equal parts of ether and 95 per cent. alcohol. Fixation for 1 or 2 minutes is adequate.
3. Stain for approximately 1 minute in Solution S3.
4. Carry through 70 per cent., 95 per cent. and absolute

<sup>1</sup> Acknowledgement is made of aid from the John and Mary Markle Foundation.

<sup>2</sup> V. A. Najjar and E. W. Wood, *Proc. Soc. Exp. Biol. and Med.*, 44: 386, 1940.

<sup>3</sup> V. A. Najjar and L. E. Holt, *SCIENCE*, 93: 20, 1941.

<sup>1</sup> *SCIENCE*, 91: 321, 1940.

<sup>2</sup> *SCIENCE*, 91: 579, 1940.

alcohol, dipping slide 10 times in each solution.

5. Clear in xylol and mount in damar.

In preparing the smear, it is important not to allow the secretion to dry before fixation, as drying alters the morphology and the staining properties of the cells. Very thick smears are also undesirable, since it is difficult to remove the excess stain from the thick areas except by prolonged washing in the alcohols. A thick secretion should be spread out thinly with the edge of the pipette, taking care to avoid drying in so doing. Most reliance can be placed in the histological picture in the thinner areas.

When single slides are stained, it is most economical and convenient to deliver the stain from a dropping bottle. If the portion of the slide containing the smear is marked off with a china-marking pencil, one or two drops of stain generally suffice. It is economical to drain the slide thoroughly and wipe off the back with a cloth or paper towel after each solution, thereby prolonging the dehydrating properties of the alcoholic solutions. The absolute alcohol can be eliminated, by blotting the slide thoroughly after rinsing in 95 per cent. alcohol, and then going directly to xylol. All solutions should be well stoppered when not in use. The use of coverslips can be avoided by using isobutyl methacrylate polymer P-5 (du Pont de Nemours and Co. Ammonia Dept., Wilmington, Del.) instead of damar. This is dissolved in xylol to yield a solution of proper consistency for mounting. After the slide is cleared in xylol, a few drops of the solution are placed on the slide to form a protective film over the smear. The slide can be examined at once, and then allowed to dry in air before filing.

While most investigators may prefer to use the complete trichrome stain previously described for research purposes, the present technic should fulfill most of the clinical requirements for a rapid simple differential stain for vaginal smears.

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#### A DEVICE FOR THE PREPARATION OF HYDROSULFITE SOLUTIONS FOR GAS ANALYSIS

A DISADVANTAGE in the use of sodium hydrosulfite solutions for the rapid absorption of oxygen in gas analysis, as suggested by Van Slyke and co-workers,<sup>1</sup> is the need for frequent renewals of the solution. This drawback could be partially overcome if a method were used by which a considerable proportion

of the hydrosulfite is not oxidized by the air during the preparation of the solution. This may be accomplished by a simple device which has been used in this laboratory for several years.

This consists of a glass tube 14 mm inside diameter and 195 mm long (volume, 30 cc), constricted at one end to a small glass stopcock. Below the stopcock, attached by means of a rubber connection and inserted into the stopcock tubing, is a 250 mm length of 3 mm outside diameter glass tubing. This tubing is to reach to the bottom of the gas apparatus container for the oxygen-absorbing solution. At the bottom of the larger tubing is a wad of fine, glass wool for filtering the solution. Twenty-five cc of 2 N KOH solution is poured into the tube, and somewhat more than  $\frac{1}{2}$  of the 15 gm of hydrosulfite is added. The tube is stoppered and shaken a few times. The solution is then run into the container, and a 2 cm layer of liquid petrolatum is simultaneously poured on to the surface. The second 25 cc of KOH solution and the remainder of the hydrosulfite are quickly added in a similar manner, and the absorbing solution is ready for use.

The useful oxygen-absorbing capacity of the hydrosulfite solution is greatly increased by this easy and rapid method of preparation.

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## THE AUTUMN GENERAL MEETING OF THE AMERICAN PHILOSOPHICAL SOCIETY, NOVEMBER 21-22, 1941

By Dr. EDWIN G. CONKLIN

VICE-PRESIDENT AND EXECUTIVE OFFICER

DURING the eighteenth and nineteenth centuries the meetings of the American Philosophical Society were held on the first and third Fridays of each month from October to May, inclusive, and the scientific programs consisted of a principal lecture and minor verbal or written communications from local members or distant correspondents. With the removal of residence of local members from the center of Philadelphia and the wider geographical distribution of the membership of the society it became increasingly difficult to get good attendance at these fortnightly meetings, and

in the early years of the present century the regular meetings began to be held monthly, while an annual general meeting was held in the month of April extending over a period of two or three days. The success of these general meetings was so great and the interest in the monthly meetings so small that the latter were abandoned in 1935 and in their place an Autumn General Meeting in the month of November was instituted, to which there was soon added a Mid-winter Meeting in the month of February, each of these extending over two full days. By thus decreas-

ing the number of meetings and increasing the length and importance of each the attendance and interest have greatly increased.

The Autumn General Meeting for 1941 was held in the Hall of the Society on Independence Square on November 21 and 22. About one hundred and ten (110) members and especially invited guests were present and registered in addition to an unknown number of persons who were present but did not register. The program of the first day of the meeting consisted of reports on the scientific results of the United States Antarctic Expedition of 1939-1941. In the main these were the first detailed reports of this latest expedition to Antarctica, which was probably better organized for scientific work than any previous expedition. Thanks are due to all who took part in this program, and especially to Dr. Serge A. Korff, who was largely responsible for its organization. Brief abstracts of these reports follow:

F. Alton Wade, senior scientist, U. S. Antarctic Service.  
An Introduction to the Symposium on Scientific Results of the United States Antarctic Expedition, 1939-41.

One of the primary purposes of the United States Antarctic Service Expedition, 1939-1941, was to carry on a comprehensive program of scientific observations and research. Through the cooperation of many of the world's leading scientists such a program was planned. A good portion of the program was carried to completion by the twenty-one members of the scientific staff. Due to extenuating circumstances and an unexpected termination of the expedition, some phases were only partially completed. Detailed observations were made and programs of research were conducted in the following fields: Auroral phenomena, bacteriology, botany, cosmic ray, glaciology, magnetism, medicine, meteorology, micro paleontology, ornithology, petrography and petrology, physiography, physiology, radio, seismology, structural geology and zoology. A few of the reports have been completed, others are nearing completion and some will not be ready for publication for months. In addition to the work as summarized in this symposium, there are to be published many more reports. Among them may be listed the following: Observations and height determinations of the Aurora Australis. The physiographic feature of the Ross Shelf Ice. The geology of the Weddell Coast of Palmer Peninsula south of 68°. The geological features and formations in the vicinity of East Base. The sedimentary rocks of the Edsel Ford Mountains. The petrography and structure of the Rockefeller Mountains. Ornithology Report; this will include observations of bird life at both bases, at the Melchior Islands and along the ships' routes. The petrography and structure of the Melchior Islands. A correlation of radio receiving and transmitting conditions with magnetic phenomena and auroral displays.

F. Alton Wade. The Physical Aspects of Shelf Ice.

The first detailed investigations of shelf ice were made

at West Base during 1940. Included in the program were the following: the variation of the density of the firn with depth, sub-surface temperature measurements to a depth of forty-one meters, variations in the snow surface level over a period of eleven months, horizontal and vertical movements within the firn, variations in the size of the constituent grains in various zones, stratification and horizontal banding. The methods used are discussed and the apparatus is described. The results are presented in tabular and graphic forms. Comparisons are made with the results as obtained from investigations of the physical aspects of other types of glaciers; namely, valley glaciers and the Greenland Ice Cap. The lack of summer melt-water in the Ross Shelf Ice eliminated what had been considered the most important factor in the process of firnification. However, without the aid of melt-water the process does proceed with much the same results. An explanation of the firnification process in regions where the air temperature seldom rises above freezing is advanced.

Paul A. Siple, geographer and leader, West Base. Geographical Discoveries from West Base.

Geographical exploration was carried on from West Base in 1940 by means of five reconnaissance field parties and two aircraft. The routes used followed but extended considerably beyond those opened first by the Byrd Expeditions 1929 and 1934. The field parties' operations were limited to the hinter coastal mountains east of Little America from longitude 164° west to longitude 136° west. The parties were occupied mainly with surveying, geology, biology and meteorology. Aerial reconnaissance and surveying extended eastward to longitude 120° west including the major land features to nearly 200 miles south of the coast. This was accomplished by six flights making more than 1,000 usable aerial survey photographs available of the area. Exploration to the west of Little America included three major flights over previously explored portions of the Ross Ice Shelf crossing in each case into meridians of east longitude in the vicinity of latitude 78° 30'; 79° 20'; 81°; 83°; and 84°. Four newly discovered areas of internal disturbance were studied and 15 bays and inlets were photographed in the continuous aerial survey of about 400 miles of barrier face from an altitude of 7,000 feet. Southern exploratory operations were confined mainly to filling in the gap of mountains in the Austral Cordillera between Beardmore and Live Glaciers. However, the character of land formations east to the 120th meridian west indicated no sea level connections between the Ross and Weddell Seas. Other geographical accomplishments included glacial studies of the formation and physiography of shelf ice; problems of human adaptation to the climate of Antarctica and studies of the cooling power of the wind.

Lawrence A. Warner, Department of Geology, the Johns Hopkins University. Geological Structure and Petrography of the Edsel Ford Ranges, Marie Byrd Land, Antarctica.

The portion of the Edsel Ford Ranges investigation by the geological party of the U. S. Antarctic Expedition lies between longitudes 143° 30' and 145° 30' W and

latitudes  $76^{\circ} 50'$  and  $77^{\circ} 15' S$  and comprises a total area of about 700 square miles. The Raymond Fosdick Mountains, immediately to the north, were investigated by a party of biologists who submitted their geological notes and specimens for investigation. Thus, reconnaissance data are available for the major portion of the Edsel Ford Ranges. The oldest outcropping rocks in the area are slightly metamorphosed sediments which consist of a remarkably uniform series of dark shales and sandstones, the total thickness of which is at least 15,000 feet. Since no fossils were found, the geological age of the series is not known. The sediments are intruded by a granitic batholith, the major axis of which appears to run roughly N-S. The major sedimentary ranges comprise a broad syncline, the axis of which trends E-W and plunges down the west flank of the batholith. Exposed contacts between granite and sediments are for the most part sharp and concordant. Dikes and linear masses of igneous material, ranging in composition from alaskite to dolerite are intrusive into the granite and sediments. These are thought to represent differentiates of the granitic magma. The region as a whole is broken by faults, along one of which there is a horizontal displacement of over a thousand feet. The strikes of the dikes and faults appear to be symmetrical to the major structures in the granite and sediments. Of relatively recent origin are basaltic lava flows which seem to be confined to a small area in the Raymond Fosdick Mountains. The major geological problems of the area are concerned with: (1) The age of the sediments and the climatic and geographic conditions under which they were deposited. (2) The mode of emplacement of the igneous bodies and the relation of the intrusives to the deformation of the area. (3) The paucity of ore deposition and pegmatization. A critical analysis of the field evidence and detailed petrographic studies in the laboratory are now in progress in the hope of shedding light on these problems.

H. G. Dorsey, Jr., U. S. Weather Bureau. An Antarctic Mountain Weather Station.

The meteorological program at the East Base of the U. S. Antarctic Expedition was featured by the establishment of a completely equipped weather outpost over a mile above sea-level on the plateau of Palmer Peninsula. Early in August, 1940, a sledging party from East Base pioneered a route to the plateau, making an ascent which previous explorers considered inaccessible to dog teams, and indicating the possibility of erecting a mountain weather station. Late in October, nearly one and a half tons of equipment were transported by four dog teams to the proposed meteorological outpost, located at  $68^{\circ} 7' S$ ,  $66^{\circ} 30' W$ . on a plateau knoll about 12 miles east of the main base. Lester Lherke, C.B.M., U.S.N., and Robert Palmer occupied the plateau weather station during November and December. Despite prevailing northeasterly storms of drifting snow, their days were well spent between living quarters in a sturdy tent and meteorological office in a snow cave. For the first time in South Polar regions, detailed high level weather data were obtained in a form suitable for comparison with nearby sea-level observations. Six-hourly check readings on all data were

taken concurrently with those at East Base, in addition to the continuous autographic records of wind, pressure and temperature. Snow accretion and ablation were measured. Pilot balloon observations of the winds aloft were especially valuable when there was a low overcast below the plateau. The mountain station contacted the base twice daily by low power radio, sending coded weather reports, which were included in the East Base weather transmissions to South America. These data and frequent special reports were helpful in forecasting for aviation operations at East Base and provide interesting material for future research on the meteorological phenomena of Palmer Peninsula.

Roy G. Fitzsimmons, Physicist, Department of Terrestrial Magnetism, Carnegie Institution of Washington. Preliminary Report on the Magnetic and Seismic Program.

During the period from April 27, 1940, to January 21, 1941, a LaCour insensitive magnetograph was in operation at Little America. Variations of the declination and the horizontal and vertical components of the earth's magnetic field were recorded. Control observations were made with a magnetometer and a dip circle. A general description of the magnetic observatory and the method of observation as well as a report on the preliminary magnetic results were given. During the period from November 17, 1940, to December 28, 1940, a McComb-Romberg seismograph was in operation at the Rockefeller Mountains. A report of the earthquakes recorded and their analysis were given.

Sergo A. Korff, assistant professor of physics, New York University. Report on Cosmic Ray Results.

The cosmic ray program of the U. S. Antarctic Service was planned with a view to throwing further light on the connections between cosmic rays and meteorology, and also on the effects produced by such high energy rays passing through matter. The first part of the program involved the operation of two meters at West Base over the Antarctic winter and a correlation of the records there obtained with temperature, pressure and other effects, such as magnetic variations, and also the operation of the instrument on board ship to obtain further data regarding the temperature coefficient and the latitude-variation. Finally, airplane flights to high altitudes were carried out, which were to be studied in connection with radiosonde data. The second part, namely, studying the effects produced by the radiation, involved (a) operating a cosmic-ray counter on shipboard for comparison with the electroscope data, (b) the operation of a neutron counter and (c) measurement of all bursts in the cosmic ray intensity on the long-term records. With respect to the first part, a pressure coefficient was determined from the data at West Base for each 15-day period of operation. It was found that the least-square solutions of the correlation between pressure and cosmic-ray intensity gave a slope (the pressure coefficient) and an intercept (the extrapolation of the cosmic ray intensity to zero pressure) both of which varied over somewhat wider limits than were anticipated. Further analysis showed that this variation was associated with changes in the light of the mesotron producing layer, but that contrary to the usual

procedure in temperature latitudes, this could not be represented as an external temperature-effect. This was found to be due to the fact that the surface temperature was not a good indicator of the distribution of the atmosphere in the column of air above the instrument. Using the radiosonde data, a new dependence upon upper atmosphere conditions was computed, and better agreement was obtained. This was checked by the runs made on ship-board in zones of different surface temperatures. It is a pleasure to acknowledge the excellent work done by Messrs. E. T. Clarke, D. K. Bailey and E. K. Smith in this connection.

Arnold Court, junior meteorologist, U. S. Weather Bureau.  
Disappearance of the Tropopause During the Antarctic Winter.

Complete disappearance of the tropopause above Little America III is revealed by the 190 radiosonde observations made from April 25, 1940, to January 15, 1941, as part of the U. S. Weather Bureau's share in the scientific program of the U. S. Antarctic Service. Summertime observations show a definite and rather warm ( $-50^{\circ}\text{C}$ ) tropopause around 9 km, above which the stratosphere is  $-40^{\circ}\text{C}$  or warmer. Spring and fall soundings clearly show the transition from the winter type, with no clearly defined stratosphere and with temperatures to  $-80^{\circ}\text{C}$ , to the summer condition. This hitherto unsuspected behavior of the upper air apparently is due to seasonal differences in radiation, but no indications of such conditions have so far been reported in the northern hemisphere, despite daily soundings at Barrow, Nome, Fairbanks and other Alaskan stations, and intensive work in Russia and Scandinavia. None of these stations, however, is as close to the pole as Little America III (800 miles). Another phase of the meteorological program, the making of 230 pilot balloon ascents, revealed the prevailing summertime wind at high levels to be southwest or west-southwest, not northwest as had previously been assumed. On the surface, observations covering an entire year were obtained, 11 months of them on a complete 4-a-day basis. Barograms were obtained in duplicate for the entire time, and thermograms except when winter cold stopped clocks. Complete wind records minute by minute were obtained from April 10 to camp abandonment on February 1.

Herwil M. Bryant, Naval Research Laboratory, Anacostia Station. Biology at East Base.

The East Base of the U. S. Antarctic Service is well situated for biological study. Stonington Island, the base of operations, lies just a hundred statute miles within the Antarctic Circle on the west coast of the Palmer Peninsula. Here great glaciers flow down to the sea between high mountains. Precipitous cliffs, many too steep to hold snow, form the shore line. Although frozen-over eleven months of the year, the relatively shallow waters along the coast are rich in marine life, attracting penguin and seal alike. During summer months sea birds are attracted to this feeding ground; some breed on the rocky shore. Two Adelie penguins' rookeries were within sledging distance of the base. Rocks exposed on the steep cliffs were often encrusted with lichens, while thawing weather

during the short summer period formed small pools of fresh water, often teeming with aquatic life. The collection of a completely representative set of specimens representing this region was a primary consideration. The U. S. National Museum has received all specimens brought back. At the present time these are undergoing exhaustive classification and investigation. In the field, a thorough study of the breeding Adelie penguin was made. Carl R. Eklund, ornithologist and assistant biologist, made studies on the body temperatures of Antarctic birds. New southern records were recorded for sub-Antarctic species such as the blue-eyed shag (*Phalacrocorax atriceps*), and the breeding southern black-backed gull (*Larus dominicanus*). Of special interest were notes on Collembola colonies and the discovery of certain mites living upon lichens, algae and mosses. At East Base, the first representative West Antarctica biological collection was prepared for an American institution and a general biological picture of this unknown region, adding to the work of Bertram and Roberts of the British Graham Land Expedition (1935-1937), was recorded.

Ernest F. Lockhart, physiologist, Massachusetts Institute of Technology. Acclimatization in the Antarctic.

An attack on the problem of acclimatization by white men in the Antarctic was made by studying the effect of sudden changes in temperature on blood pressure, heart rate and respiration rate. This work was extended with data on typical body temperature, blood pressure, heart and respiration rates and metabolism under basal conditions. A study of blood sugar levels was also made. The results of these studies may be summarized as follows: Although pulse pressure is not affected significantly, systolic and diastolic pressures increase 25 to 35 per cent. when a sudden change in temperature is the stimulus. Both the respiration rate and the heart rate are decreased somewhat. Under typical basal conditions pulse and respiration rates, blood pressure and body temperature are slightly lower than normals recorded in temperate climates. Basal metabolism averages 10 to 15 per cent. lower than that reported for temperate climates. Blood sugar levels, on the other hand, are slightly above the normal limit of 120 mg per cent. Although the results presented should be extended, those now at hand indicate that an acclimatization does take place in white men when subjected to the extreme conditions prevalent in the Antarctic. It is suggested that the acclimatization process is begun by the continual pressor action of the low temperature. This primary stimulus, when repeated frequently, as is the case, induces hypo-effects in the several endocrine systems principally involved in metabolism.

The Friday evening lecture was given by Vilhjalmur Stefansson on "Military Aspects of the Arctic," and was an able and timely contribution to this important subject.

The program on Saturday morning consisted of ten papers, eight of them being from recipients of grants from the research funds of the society. The chief results of these researches are given in the following brief abstracts:

Lester W. Strock, geochemist, Saratoga Springs Laboratory. The Geochemical Genesis of Saratoga Mineral Waters and the Spectrochemical Analysis of Their Characteristic Trace Elements.

The more abundant constituents of the mineral waters occurring at Saratoga Springs, N. Y., have been traced to four geochemically distinct sources. These sources, listed in the order in which the parent ground waters obtain their materials from them, are: (1) the "Camillus" lime mud rock of the central New York Silurian formations which furnish the potassium and bromides and which has been interpreted in this work as a "bittern shale"; (2) the rock salt beds of the same Silurian formations which supply the chlorides and most of sodium; (3) older shales and limestones underlying the salt beds from which some additional sodium, all the iodides, a very small portion of the potassium, and about half the calcium is obtained; and (4) the Little Falls dolomite which furnishes the other half of the calcium and nearly all the magnesium present in the Saratoga waters. The synthesis of Saratoga mineral waters in these four distinct stages progresses as the parent ground waters move in a general eastward and later northeastward direction toward the Saratoga region from central New York. During a large portion of their course they are confined in the Little Falls dolomite, in which they are trapped in the Schenectady basin. Their further movement eastward is blocked by a buried crystalline ridge, so that they are forced up-grade toward Saratoga by the pressure of new waters from the west. Quantitative spectrochemical determinations are being made of the lesser abundant elements in Saratoga waters, and all typical rocks of the geological formations involved in the above proposed theory of their origin. The elements zirconium and tin are strongly enriched in the waters. Beryllium is enriched to a smaller extent, while manganese, cobalt and nickel are strongly depleted. Iron has been used as an empirical abundance standard and the abundance ratios for the waters compared with similar ones for the earth's silicate crust. The several thousand-fold enrichment of zirconium over titanium in Saratoga water, compared with the known ratio of these two elements in the earth's crust, is proof of the exceptional geochemical properties of these saline-bicarbonate-rich mineral waters. This discovery has served as an additional incentive to search for new geochemical processes in nature by a spectrochemical analysis of the trace elements occurring in solution in all parts of the earth's hydrosphere.

Carl G. Vinson, professor of horticulture, University of Missouri. Isolation of Crystalline Tobacco Mosaic Virus Protein Using Water Miscible Solvents.

A modified method has been developed for isolating tobacco mosaic virus from juice of diseased plants. In this method a strong acid-phosphate buffer solution is used as the precipitating agent. There is no danger of inactivating the virus due to extremes of hydrogen ion concentration. Crystalline form of many substances often is determined by the character of the dispersion medium. No true crystals of the virus of tobacco mosaic have been

obtained, however, from any of a large number of organic substances, miscible with water, when used in forcing the virus out of an aqueous dispersion. Acetonyl acetone has been found superior to ether in removing the pigment associated with the virus in juice of diseased plants.

Leslie A. Chambers and Werner Henle, Johnson Foundation, University of Pennsylvania. Concentration, Isolation and Determination of the Size of the Virus of Influenza A.

The infectious agent of influenza A, as it occurs in emulsions of infected mouse lung, is associated with particles about 100 m $\mu$  in diameter. Particles of similar size, chemical composition, density, staining properties and electron-microscopic appearance are derivable from normal lung tissue. Virus contained in the extra-embryonic fluids of infected chick embryos is not associated with such large structures, but may be absorbed completely from such fluids by the particles derived from normal lung tissue. This, together with other evidence, indicates that a component of normal cells may act as carrier of a considerably smaller pathogenic agent. Concentration of the virus from extra-embryonic fluids was accomplished by precipitation with protamine. Analysis of the resulting infectious complex indicates that the virus consists largely, if not entirely, of nucleoprotein. Ultra-centrifugation at about 90,000 g for 90 minutes sedimented almost all the infective material from egg fluids. Sedimentation diagrams of the resuspended sediment showed two components to be present. One of these gave a well-defined boundary and had a sedimentation constant of  $31 \times 10^{-13}$  corresponding with a particle size of about 12-14 m $\mu$  and a molecular weight of about 1,000,000. Fractionation by ultra-centrifugation, followed by protein analysis and infectivity tests, indicated that the heavier, less homogeneous component ( $S_{20} =$  about  $800 \pm 100 \times 10^{-13}$ ) consisted, almost entirely, of aggregates of the smaller units. The two sedimentable fractions were infectious in approximately equal dilutions. A minimal infectious dose contained about  $10^{-10}$  grams and therefore consisted of less than 100 particles. A size distribution curve based on measurement of electron-micrographs of the isolated virus protein showed the particles to be essentially spherical and to have a modal diameter of about 11 m $\mu$ . This is in good agreement with the estimates based on the sedimentation constant  $S_{20} = 31 \times 10^{-13}$ . In view of this evidence the virus of influenza A must be regarded as one of the smallest pathogenic agents yet isolated.

Herbert Shapiro, Department of Physiology, Hahnemann Medical College, Philadelphia. The Parthenogenetic Activation of Rabbit Eggs in the Unoperated Animal.

It has been shown in earlier work that cold is an effective agent in initiating artificial parthenogenesis in rabbit ova, *in vitro*. By inducing rabbits to ovulate as the result of a course of pituitary extract injections, tubal eggs of known age could be cooled *in situ* in the anesthetized animal, under sterile surgical conditions, by circulating cold water through a metal jacket into which the tube

was inserted. This mode of treatment did in one instance lead to the birth of a normal parthenogenetic female, capable of normal reproduction, which at this writing, months later, is still living. In the present series of experiments, rabbit eggs were activated parthenogenetically in the intact animal, without operating surgically. Rabbits were made to ovulate as usual by pituitary injections. Cooling of the entire animal was effected by applying an ice pack to the doe's flank, directly over the region of the Fallopian tube, as she lay anesthetized on the table. Rectal temperature, respiration and pulse rate were recorded at regular intervals. The uterine tube, which lies just under the abdominal musculature, was very likely brought to a temperature lower than that indicated by the rectal thermometer. Body temperature (normally about 39.7° C., in the rabbit) was lowered to points varying from 33.6° C. to 18.0° C. (92.5° F. to 64.4° F.). In all experiments, perfect recovery of the animals occurred. Eggs were secured at various intervals after the experiment by flushing the Fallopian tube, and they were then fixed and sectioned for microscopic study. Artificial parthenogenetic activation was obtained in two animals, one of which contained two eggs in two cell stage, when examined 40 hours after the activating treatment, and another contained a young embryo in the early morula stage. More advanced stages in embryogenesis have not thus far been obtained.

Francis Harper, research associate, the John Bartram Association, Philadelphia. William Bartram's Status as a Naturalist.

Bartram's accuracy and even his integrity have been occasionally questioned for more than a century. Among his critics have been J. E. LeConte (in 1830), J. A. Allen, F. W. True, T. G. Pearson, A. H. Howell and Remington Kellogg. His defenders have included William Baldwin, J. E. LeConte (in 1854, making handsome amends for his earlier criticism), Sir Charles Lyell, Elliott Coues and the present writer. Most of the criticism directed against Bartram has revolved about his accounts of the Alligator and the "Painted Vulture." Recent investigations have amply vindicated him on both points. To Bartram natural history was scarcely an exact science, but a study to be interpreted with something of a poet's vision. He was thus entitled to a little poetic license and occasionally availed himself of it. Now and then he seems to have trusted a faulty memory. He was frequently inaccurate in matters of dates, distances and dimensions. He lacked a proper training in taxonomy. But these shortcomings scarcely affect the general soundness and accuracy of his observations on plants, animals and Indians. There can be no question of his fundamental integrity as a naturalist. His "Travels" provides a priceless record of American natural history in the eighteenth century.

Helen C. Palmatary, Kensington High School, Philadelphia. Recent Archeological Studies in Amazonia.

In the summer of 1941 I went to Belém, Brazil, for the purpose of studying the Marajó pottery in the Museu Goeldi, also the private collection of Dr. Carlos Estevam,

director of that museum. In addition to the museum work, I made a trip to Marajó Island accompanied by Dr. Carlos Estevam, and visited two important sites there—Pacoval, an artificial island in Lago Arary, where the ancient Indians buried their dead, and Santa Brigida, an important but little known site. Dr. Estevam did some excavating at the latter site. The section of the island from which the pottery comes is flat campo land, badly flooded for more than half the year; it has neither trees suitable for building material nor stone from which implements can be made. Brief references were made to some of the problems which present themselves in connection with an effort to partially reconstruct the ancient culture or cultures of Marajó.

Charles Grosvenor Osgood, professor emeritus of English, Princeton University. The Variorum Edition of the Works of Edmund Spenser, Especially of the Minor Poems.

The Variorum Edition of the Works of Edmund Spenser, first proposed by the late Edwin Greenlaw, of the Johns Hopkins University, and carried on since his death by Dean Frederick M. Padelford, Ray Hoffner and myself, has already published six volumes containing the *Faerie Queene* with full "variorum" apparatus. The present project, for which as special editor I am responsible, is the editing of the "Minor Poems" of Spenser. These will occupy two volumes larger than any yet issued. The first of these is in press, the second largely compiled, though not fully checked and revised. The work of a "Variorum" editor is twofold: (1) the preparation of a new text embodying all the help of preceding editors and a new collation of all the early editions; (2) the assembling, appraising, sifting, arranging and condensing of all relevant comment and lucubrations, and the addition of the editor's comment where it is called for. We trust that the text of the "Minor Poems" which we have established will become the definitive text. Certainly no other edition has included the examination of so many copies of the earliest editions. I have assembled and weighed all the widely scattered material I can find which will serve to elucidate the poet's meaning and the composition of the work.

Leonard G. Rowntree, chief, U. S. Medical Division, Selective Service. The Health of Registrants and the President's Plan of Rehabilitation.

Selective Service is charged with the function of procurement of men for the Army. More than 17,000,000 men have been registered to date and more than 2,000,000 have been examined. The average height of registrants examined is 67½ inches. This figure is identical with that obtained for the Army in World War I. The average weight of registrants is 150 pounds, which is 8 pounds heavier than the average for the men examined for the Army in the last war and 14 pounds more than the average for soldiers in the civil war. Selective Service examinations reveal that great differences exist in the health in various parts of the country. A "health belt" is found in a group of western states centering around Colorado. A somewhat similar belt of good health was found to exist

during the last war. The poorest physical state is encountered in some of the southern states. The difference in health in these areas is quite marked; thus for every 10 men examined in Colorado 7 are found acceptable, whereas in one of the southern states only 3 are acceptable. The physical fitness varies greatly with age. The average age of the registrants was 25.7 years. Of those 21 years of age, more than 60 per cent. were fit, whereas those 36 years of age less than 30 per cent. were fit. The Selective Service and Army boards have rejected as unfit for military service approximately 50 per cent. of the registrants examined. About 100,000 are rejected for illiteracy; 430,000 are totally unfit for military service, and 470,000 are classified as 1-B; that is they might be fit for limited military service were they acceptable under Army standards. These figures are not to be interpreted as representing 50 per cent. invalidism of the registrants examined, or as indicative of 50 per cent. illness of the population in general. They simply represent unfitness for military service according to the standard requirements that have been set up by the Army.

These cases of rejections are listed in Table 1.

Because of the relatively poor physical state of 50 per

cent. of the registrants examined and the urgent need for manpower for national defense, the President has suggested that as many as possible of those rejected be rehabilitated. It is estimated that around 200,000 have remediable defects. This work of rehabilitation has been assigned to the Selective Service System. Plans have been formulated and the work is already under way. Rehabilitation is to be carried out in the registrant's home community. Funds are to be provided for the medical and dental services necessitated in the rehabilitation program.

TABLE I

Cause	No. of cases	Percentage
Dental defects .....	188,000	20.9
Defective eyes .....	123,000	13.7
Cardiovascular diseases .....	96,000	10.6
Musculo-skeletal defects .....	61,000	6.8
Veneral diseases .....	57,000	6.3
Mental and nervous diseases .....	57,000	6.3
Hernia .....	56,000	6.2
Defects of ears .....	41,000	4.6
Defects of feet .....	38,000	4.0
Defective lungs, including tuberculosis .....	26,000	2.9
Miscellaneous .....	159,000	17.7
Totals .....	900,000	100.0

## OBITUARY

### RUDOLF SCHOENHEIMER, 1898-1941

RUDOLF SCHOENHEIMER was born in Berlin, where he received his early education and university training. After receiving the medical degree from the University of Berlin in 1922, he held for a year the position of resident pathologist in the Moabit Hospital of that city. There his interest was attracted by the problem of atherosclerosis and his first published works, dating from that period, relate to the production of this condition in experimental animals by the administration of cholesterol. Recognizing his need for a wider knowledge of biochemistry, he then studied for three years under Karl Thomas of Leipzig, from whose laboratory he published, early in 1926, an ingenious method for the preparation of peptides. During these years of supplementary training, Schoenheimer held a fellowship of the Rockefeller Foundation.

The next move was to the Pathological Institute of the University of Freiburg, where in 1926 he joined, as chemist, the staff of Ludwig Aschoff, who exerted a marked influence on his scientific development. Here, along with his regular duties in the investigation of pathological material, he again took up the biochemical study of the sterols. In 1927 he became the active, and in 1931 the titular, head of his division. During this period his researches related mainly to the metabolism of cholesterol and were continued in this field when, in 1930, he came to this country for a year as Douglas Smith Fellow in the Department

of Surgery of the University of Chicago. After his return to Freiburg in 1931 his work, continued with the support of the Josiah Macy Jr. Foundation, was rudely interrupted by political developments within Germany in the spring of 1933. The last study completed in the Freiburg laboratory was reported in the *Journal of Biological Chemistry*; it established the important finding that in the normal mammalian organism cholesterol is continually and extensively synthesized and degraded in the tissues.

The Department of Biochemistry of Columbia University was fortunate in being able to provide facilities for Schoenheimer's subsequent researches. The first report published by him from this laboratory, recording the normal occurrence of cetyl alcohol in intestinal contents, has a peculiar significance in its bearing on his subsequent work on the intermediary metabolism of fatty acids. In collaboration with W. M. Sperry, he developed a valuable method for the precise determination of minute quantities of free and combined cholesterol and applied this technique to a comparative study of serum and plasma.

In 1934 Schoenheimer made a new contact which proved to exert a fundamental influence on the nature of his work. In order to exploit the availability of deuterium, discovered by Urey in 1932, for the development of biological research, the Rockefeller Foundation established a fund to enable chemists trained in deuterium techniques to apply their special knowledge to biochemical and allied problems. Under these

auspices David Rittenberg came from Urey's group to the laboratory in which Schoenheimer had been working for a year. From their association there developed the idea of employing a stable isotope as a label in organic compounds, destined for experiments in intermediary metabolism, which should be biochemically indistinguishable from their natural analogues. Justification for this scheme was found in the established fact that the hydrogen in organic matter displays the same isotope abundance as that in common water. Exploratory experiments soon showed that the feeding of 4,5-deuteriocoprostanone led to the presence of deuteriocoprosterol in the feces and that the ingestion of fat containing combined deuterio-stearic acid was, surprisingly, followed by the rapid deposition of a large proportion of it in the body fats.

A similar effect was then observed to occur in animals the body fluids of which were enriched with heavy water; deuterio fatty acids appeared in the depot fats and reached a maximum in a strikingly short time. Conversely, with ordinary water in the body fluids, the isotopic label in the depot fats disappeared equally rapidly. This rapid interchange between components of the diet and of the tissues proved on further investigation to involve not only direct replacement of chemically identical fatty acids but rapid transformations, notably desaturation, saturation, degradation, elongation and reduction to alcohols. The only natural fatty acids which appeared not to be synthesized by the rat were the highly unsaturated acids known to be essential for health.

As soon as the stable isotope of nitrogen,  $N^{15}$ , became available, Schoenheimer and his colleagues applied it to an analogous study of protein metabolism. Amino acids synthesized from isotopic ammonia and added in small quantities to the diet of adult rats in nitrogen equilibrium were found to be rapidly and extensively incorporated in the tissue proteins. Like the fatty acids, they also gave evidence of chemical transformations; after the ingestion of isotopic amino acids or ammonia, heavy nitrogen was found in all amino acids isolated from the proteins, except lysine. Advantage was also taken of the possibility of labeling compounds with both isotopes, the ratio of which in the products isolated from tissue proteins indicated the extent to which the carbon chain of an amino acid had followed a different metabolic pathway from that of the nitrogen atom.

As a result of Schoenheimer's investigations, of which but a few examples have here been outlined, there has emerged a concept of metabolic "regeneration," wherein the central idea is the continual release and uptake of chemical substances by tissues to and from a circulating metabolic "pool." Coincident with

these cyclic processes there occur among the components of the pool multitudinous chemical reactions, of which only relatively few are concerned with elimination of waste products. These general interpretations were summarized by Schoenheimer in his Harvey Lecture of 1937 and his Dunham Lectures of 1941.

Schoenheimer died by suicide, at the height of his productive career, on September 11, 1941. Few men had more reason for desiring to live; his work gave him intense satisfaction, and its increasing importance was widely recognized. He was surrounded by devoted friends; all who knew him held him in admiration and affection. He leaves his mother, a brother; his widow, Salome Glucksohn Schoenheimer, is an accomplished embryologist.

One of Schoenheimer's most striking characteristics was his ability to correlate pertinent facts from highly diversified branches of knowledge and bring them to bear upon problems under immediate consideration. He not only sought the advice of experts in fields other than his own, but freely discussed his scientific plans with his colleagues as well as his direct collaborators. He led his research group with tact, understanding and constant stimulation.

HANS T. CLARKE

DEPARTMENT OF BIOCHEMISTRY,  
COLLEGE OF PHYSICIANS AND SURGEONS,  
COLUMBIA UNIVERSITY

## DEATHS AND MEMORIALS

DR. THOMAS HERBERT NORTON, research chemist, from 1883 to 1900 professor of chemistry at the University of Cincinnati, died on December 2 at the age of ninety years.

DR. CLYDE SHEPARD ATCHISON, since 1912 professor and head of the department of mathematics at Washington and Jefferson College, died on November 21, at the age of fifty-nine years.

DR. FREDERICK HUTTON GETMAN, director of the Hillside Laboratory at Stamford, Conn., from 1909 to 1915 associate professor of chemistry at Bryn Mawr College, died on December 2 at the age of sixty-four years.

A MEMORIAL service for the late Walter Granger under the auspices of the American Museum of Natural History and the Explorers Club of New York was held on November 25.

ACCORDING to an Associated Press dispatch the Government of Newfoundland has issued a five-cent postage stamp in honor of the late Sir Wilfred Grenfell, medical missionary, commemorating the fiftieth anniversary of the founding of the Grenfell Mission.

## SCIENTIFIC EVENTS

## THE SHORTAGE OF PHYSICIANS IN THE UNITED STATES

THE acute shortage of physicians in the United States, which has become critical in certain areas due to the added requirements of the Army and Navy and defense industries, is discussed in a report by the National Committee for Resettlement of Foreign Physicians, published in the *Journal* of the American Medical Association. For almost three years this committee, of which Dr. David L. Edsall is chairman and Dr. Tracy J. Putnam, vice-chairman, has been assisting qualified emigré physicians to adapt themselves to American standards and resettling them in those medically under-manned areas of the country where they can be most useful.

Fifteen hundred qualified emigré physicians are available for placement in rural districts or in hospitals which are in serious need of internes. The committee already has a record of more than twelve hundred successful placements, seven hundred in hospitals and five hundred in rural practice. Four thousand physicians have registered with the committee out of the total of fifty-five hundred foreign physicians who have come to the United States in the past eight years.

American medical authorities may well follow the plan which the British have adopted to take advantage of the services of emigré physicians. Our own needs are no less urgent. The Office of Production Management and other agencies estimate that within the next six months there will be a ten per cent. decrease in the number of physicians available for civil wants. Certain states will be more seriously affected than others. The steady shift of American physicians from rural to urban areas in the past fifteen years has resulted in a serious disproportion in the ratio of physicians to the population. Only twenty per cent. of the medical graduates of 1920 to 1925 have settled in communities of 5,000 or less, even though such communities contain nearly half the population of the country. The general proportion of physicians in cities of 100,000 or over increased from 37.9 per cent. in 1923 to 46.2 per cent. in 1931.

The committee urges that serious consideration be given immediately to the problem of speeding up the resettlement of emigré physicians. The House of Delegates of the American Medical Association has officially recommended the use of these physicians. Federal Public Health authorities have recorded similar opinions. Under the present circumstances, it would be unwise to overlook any opportunity to supply medical services to those areas which need them most.

The American Medical Association and the Public Health authorities should take up this task, in the opinion of the committee. The successful records of the men and women placed by the committee are proof of their adaptability to our national needs. Proper resettlement and the acceptance of some qualified emigrés for Army and Navy needs, the Indian Service and other public agencies will protect native Americans against permanent loss of practice, if called to military service. This will also avoid overcrowding and undue competition in many cities.

## THE NATIONAL MALARIA COMMITTEE

At the twenty-fourth annual meeting of the National Malaria Committee, held at St. Louis, Mo., from November 11 to 13, held conjointly with the Southern Medical Association, an amendment to the constitution was adopted whereby the name of the organization was changed to the National Malaria Society. Plans were developed for the publication of a periodical, to appear initially as an annual, which will be known as the *Journal* of the National Malaria Society. Publication will be in charge of an editorial board appointed for staggered three-year terms. The initial board includes Colonel Charles F. Craig, M.C., U.S.A., Ret., Dr. Justin Andrews and Nelson H. Rector. The officers elected include:

*Honorary President*, Dr. L. O. Howard, Washington, D. C.

*President*, J. H. O'Neill, New Orleans, La.

*President-elect*, Colonel J. S. Simmons, Washington, D. C.

*Vice-president*, Dr. H. W. Brown, Chapel Hill, N. C.

*Secretary-Treasurer*, Dr. Mark F. Boyd, P. O. Box 997, Tallahassee, Florida.

The president appointed Dr. H. C. Clark, Panama City, representative from the society to the council of the American Association for the Advancement of Science.

The unexpected death of Dr. J. N. Baker, Montgomery, Ala., the chairman, three days before the meeting, was deeply felt by all in attendance.

## RESIGNATION OF DR. RAPPLEYE AS COMMISSIONER OF THE DEPARTMENT OF HOSPITALS OF THE CITY OF NEW YORK

THE following resolution has been passed by the council of the New York Academy of Medicine:

When Dr. Willard C. Rappleye agreed to assume the duties of Commissioner of the Department of Hospitals of the City of New York, it was with the understanding that it would be for a year and three months, that is, to

the end of the second term of the mayor's incumbency in office, so that he might return to his duties as Dean of the College of Physicians and Surgeons of Columbia University on January 1, 1942.

To the difficult task of Commissioner of Hospitals, Dr. Rappleye brought his recognized administrative ability, vigor, persuasive powers and a high civic spirit. These qualifications blended very well with the pattern which had been developed by his predecessor and as a result the work of the Department of Hospitals has continued on a high plane to the benefit of the sick, of medical education and of community relationships.

In view of the pending resignation of Dr. Rappleye, the New York Academy of Medicine wishes to go on record as urging him to continue as Commissioner of Hospitals, particularly in view of the exceptionally heavy responsibilities which the Department of Hospitals is to face during this period of national peril.

Copies of the resolution were addressed to President Butler, of Columbia University, and to the mayor, Fiorello La Guardia.

#### THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

THE American Society of Mechanical Engineers at its annual dinner on December 3 conferred five honorary memberships, which were presented by William A. Hanley, the retiring president. These were Clarence Decatur Howe, minister of munitions and supplies for Canada; Rear Admiral Samuel M. Robinson, chief of the Bureau of Ships, U. S. Navy; Major General Charles M. Wesson, chief of ordnance, U. S. Army; Leon Pratt Alford, chairman of the department of administrative engineering, New York University, and Aurel Stodola, formerly professor of mechanical engineering, Technical University, Zurich, Switzerland.

James W. Parker, vice-president in charge of engineering of the Detroit Edison Company, took office as president on December 5. He succeeds William A. Hanley as president of the society.

Four newly elected vice-presidents and three new managers of the society also took office as members of the council. The vice-presidents, who will serve until December, 1943, are Clarke F. Freeman, of Providence, R. I., senior vice-president and engineer of the Manufacturers Mutual Fire Insurance Company; Clair B. Peck, managing editor of *Railway Mechanical Engineering*; W. H. Winterrowd, vice-president in charge of operations, Baldwin Locomotive Works, Eddystone, Pa., and W. R. Woolrich, dean of the College of Engineering of the University of Texas.

The new managers, elected until December, 1944, are; William G. Christy, smoke abatement engineer of Hudson County, N. J.; Herbert L. Eggleston, manager of gas and refining departments, Gilmore Oil

Company, Los Angeles, and Thomas S. McEwan, consulting management engineer of Chicago.

#### AWARD TO THE DOW CHEMICAL COMPANY

THE 1941 Award for Chemical Engineering Achievement was presented on December 2 at a dinner at the University Club, New York City, to the Dow Chemical Company, Midland, Mich., for its pioneering research in the recovery of metallic magnesium from sea water. The presentation was made by Colonel Alfred H. White, chairman of the award committee and head of the department of chemical and metallurgical engineering of the University of Michigan. The award is presented biennially by the McGraw-Hill magazine, *Chemical and Metallurgical Engineering*, to the company which in the opinion of the Committee of Award has contributed the most meritorious advance to the industry and profession. In presenting the award to Dr. Dow, Colonel White said:

The company which receives this award has a wonderful record of past achievement in development of processes and also in development of men. The award is made for a very recent specific achievement, but this achievement would not have been possible without the organization built up through many years.

Since 1940 this company has built on the coast of Texas a huge plant constructed primarily to extract metallic magnesium from the ocean water, but also to manufacture bromine, ethylene bromide and a number of other chemicals. This is the first plant in the world to extract metal commercially from ocean water. It is for this specific achievement that the 1940 Award for Chemical Engineering Achievement is conferred.

Dr. Willard H. Dow, president and chairman of the board of the company, accepted the bronze plaque symbolizing the award in behalf of his company. S. D. Kirkpatrick, editor of *Chemical and Metallurgical Engineering* and president-elect of the American Institute of Chemical Engineers, acted as toastmaster and introduced the speakers. The dinner was held in connection with the eighteenth National Exposition of the Chemical Industries, at Grand Central Palace.

The award was established in 1933 and is presented biennially in recognition to group effort and accomplishment of a company rather than to an individual. Previous recipients of the award are:

1933, Carbide and Carbon Chemicals Corporation for the development of synthetic organic chemicals from petroleum and natural gas. 1935, Organic Chemicals Department of the du Pont Company, for the development of synthetic rubber from acetylene and synthetic camphor from American turpentine. 1937, Standard Oil Development Company for synthetic aviation fuels and related products from petroleum. 1941, the Dow Chemical

Company for the development of a successful process for recovering metallic magnesium from ocean water—the first metal to be obtained in commercial quantities from the ocean in the history of the world.

#### AWARDS OF THE CHARLES FREDERICK CHANDLER MEDAL

AWARDS of the Charles Frederick Chandler Medal of Columbia University have been made to two brothers, Dr. Robert R. Williams, chemical director of the Bell Telephone Laboratories of New York, and Professor Roger J. Williams, of the University of Texas.

Dr. Robert R. Williams was cited for "his years of work on the isolation of Vitamin B<sub>1</sub> and his contributions to the elucidation of its chemical structure." Vitamin B<sub>1</sub>, which he synthesized and named thiamin, is the antineuritic beriberi vitamin, vital to nerve health and life.

The award to Professor Roger J. Williams was made in recognition of his discovery of pantothenic acid, powerful regulator of growth popularly known as "the acid of life" and for his contributions to the knowledge of the Vitamin B complex.

This is the first double award of the medal since it was established in 1910 in honor of Dr. Charles Frederick Chandler, professor of chemistry at Columbia University, pioneer in industrial chemistry. The formal presentation will take place in February at a ceremony in Havemeyer Hall, at which each of the 1942 recipients will receive a medal and each will deliver a lecture.

Dr. Robert R. Williams, in addition to his work on Vitamin B<sub>1</sub>, has contributed to industrial chemistry through his leadership of an organization of 140 workers in the Bell Telephone Laboratories, of which he has been chemical director for the last seventeen years.

Pantothenic acid, for the discovery of which Dr. Roger J. Williams received the award, is one of the most important components of the vague "bios" of the period twenty years earlier. It represents the first example of a compound whose structure has been elucidated in spite of the fact that its isolation in pure form has so far not been possible.

In investigating bios Dr. Williams, working with the purest material he could obtain, devised new modes of characterization of the substance in terms of physico-chemical and physiological properties which furnished the clues for the later verification of its structure by synthesis at the Merck Laboratories with his collaboration. This work led to the exploration of many other plant growth stimulants to which he gave the name "nutralites."

Professor Arthur W. Thomas was chairman of the Chandler Award Committee. Other members were Professors Leo H. Baekeland and Arthur W. Hixson. There have been seventeen previous recipients of the medal. The last award was made in 1939 to Thomas H. Chilton, director of the technical division of the engineering department of E. I. du Pont de Nemours and Company at Wilmington.

## SCIENTIFIC NOTES AND NEWS

THE John Fritz Medal for 1942 has been awarded to Dr. Everette Lee DeGolyer, consulting petroleum engineer, of Dallas, Texas, and president of the Felmont Corporation, in recognition of his work on the application of geophysical exploration to the search for oil fields. The award, which is sponsored by the four leading national engineering societies, will be presented to Dr. DeGolyer at a dinner of the American Institute of Mining and Metallurgical Engineers at the Waldorf-Astoria Hotel, New York City, on January 14.

DR. TOM DOUGLAS SPIES, of the School of Medicine of the University of Cincinnati and Hillman Hospital, Birmingham, Ala., in recognition of his work with nicotinic acid, was presented at a meeting on December 8 in Washington with the Award of Distinction of the American Pharmaceutical Manufacturers' Association. This award is made annually to an investigator who, in the opinion of the committee, has made a fundamental contribution to public health in the field of drug therapy. Last year Dr. Perrin

Long, of the Johns Hopkins School of Medicine, received the award for his study of the use of the sulfa drugs.

THE Lister Medal for 1942, which is given in recognition of distinguished contributions to surgical science, has been awarded to Dr. Evarts A. Graham, professor of surgery in Washington University, and he will deliver the Lister Memorial Lectures in 1942, or later, under the auspices of the Royal College of Surgeons of England.

THE council of the Royal Horticultural Society, London, has made the following awards for the year 1941: Victoria Medal of Honor.—E. L. Hillier, for his work in the introduction of new and rare plants. Associateship of Honor.—W. D. Besant, director of parks and botanic gardens, Glasgow; G. F. Hallett, head gardener at Lilford Hall, Oundle, Peterborough; F. Streeter, head gardener at Petworth Park, Sussex; H. Windibank, head gardener at Frensham Hall, Haslemere. Veitch Memorial Medals and Prizes.—B. Y. Morrison, Washington, D. C., gold medal for

his work for horticulture both in America and in England; R. F. Wilson, gold medal for his work in connection with the horticultural color chart; Mrs. Malby, silver medal and £25 for her photographic work on garden subjects. Loder Rhododendron Cup.—Dr. J. Macqueen Cowan, for his work on the botany of the rhododendron.

A NEW wing of the Barros Luco Hospital at Santiago, Chile, has been named for Dr. Joseph Francis McCarthy, professor of urology at Columbia University and director of the department of urology of New York Polyclinic Medical School and Hospital.

DR. ERNEST ESCLANGON, professor of astronomy at the University of Paris, director of the Paris and Meudon Observatories, has been elected president of the French Academy of Sciences for 1942.

DR. ROY YOUNG has been elected president of the Royal Faculty of Physicians and Surgeons at Glasgow.

At the annual meeting at St. Louis on December 4 of the American Society of Refrigerating Engineers, Dr. William R. Hainsworth, of New York, vice-president in charge of engineering of Servel, Inc., who has been engaged for more than twenty years in research on the problem of refrigeration, was elected president. He succeeds L. L. Lewis, vice-president of the Carrier Corporation, Syracuse, N. Y.

At the second annual meeting of the Nevada Academy of Natural Sciences, held on November 19 at the University of Nevada, Ira La Rivers, of Reno, was reelected president, J. R. Alcorn, of Fallon, was elected vice-president, and Dr. Harry E. Wheeler was elected secretary-treasurer. Dr. Philip A. Lehenbauer, Dr. W. D. Billings, Dr. Frank Richardson, Dr. E. W. Lowrance, all of Reno, were elected members of the executive committee.

DR. JAMES H. MCGREGOR, since 1924 professor of zoology at Columbia University, who has been associated with the faculty since 1897, when he was appointed assistant in zoology, will retire next year. The Pre-Medical Society of the university is giving a testimonial banquet in his honor on December 12.

DR. JOHN BEATTIE, conservator of the museum and director of research of the Royal College of Surgeons of England, has been appointed Bernhard Baron research professor of the college.

DR. HIRAM A. JONES, director of health and physical education for the State of New York at Albany, has been elected chairman of school and of the college coordinators for the national health program.

DR. JULIUS SENDROY, JR., of the department of experimental medicine of Loyola University School of

Medicine, has accepted an assignment under the National Research Defense Committee.

DR. C. STACY FRENCH, research instructor in chemistry at the University of Chicago, has been appointed assistant professor in the department of botany of the University of Minnesota.

DR. ROBERT A. MILLER, director of libraries at the University of Nebraska since 1937, has been made director of libraries at Indiana University. He will take up this work on March 1.

PROFESSOR CHARLES G. KING, of the University of Pittsburgh, and Dr. H. E. Longenecker, Buhl Foundation research fellow and assistant professor of chemistry at the university, will direct a study on the nature of fats and oils under the first of the fellowships in nutrition recently offered by Swift and Company, Chicago, of which Dr. R. C. Newton is vice-president in charge of research. Dr. Karl F. Mattil, of the Pennsylvania State College, has been appointed research fellow under the Swift grant. He will study the nutritive properties of foods and their application to the improvement of American diet and health.

DR. RAY TREICHLER has been appointed by the U. S. Fish and Wildlife Service to take charge of the recently established biochemical unit in the Food Habits Laboratory at the Patuxent Research Refuge at Bowie, Md. He will be engaged chiefly in chemical and nutritional investigations of the natural foods of wildlife and in biochemical studies of animals in the laboratory to determine the effects of different diets.

DR. JULIAN HUXLEY, secretary of the Zoological Society of London, has arrived in New York after traveling to Canada from England in a convoy. He will lecture on war-time changes in Great Britain.

DR. C. H. KELLAWAY, director of the John and Eliza Hall Institute, Melbourne, Australia, is visiting the United States.

PROFESSOR JOE WEBB PEOPLES, of the department of geology of Wesleyan University, is spending part of a sabbatical year at Northwestern University. In collaboration with Professor A. L. Howland he is at work on a government report.

THE Rockefeller Foundation has made a grant of £1,000 to the University of Oxford towards the cost during 1942 of research on the growth of and regeneration of nerves to be undertaken by Dr. J. Z. Young in the department of zoology and comparative anatomy.

DR. WALDEMAR KAEMPFERT, science editor of *The New York Times*, gave on December 11 the first of a series of lectures and demonstrations on modern developments in industry, under the auspices of the

department of vocational education of the New York University School of Education. He spoke on "The Contribution of Science to Industrial Development."

DR. ARNO B. LUCKHARDT, professor of physiology at the School of Medicine of the University of Chicago, lectured under the auspices of the Robert Sonnenschein Study Group for Medical History at the Michael Reese Hospital on December 10 on "Dr. William Beaumont and the Medical Epic of the Northwest Territory."

DR. ROBERT F. LOEB, professor of medicine at the College of Physicians and Surgeons, Columbia University, will deliver on December 18 the third Harvey Society Lecture of the current series at the New York Academy of Medicine. He will speak on "The Adrenal Cortex and Electrolyte Behavior."

DR. FREDERICK A. COLLIER, professor and director of the department of surgery at the University of Michigan Hospital, will give the ninth E. Starr Judd Lecture at the University of Minnesota on January 21. He will review "Studies on Water and Electrolyte Balance in Surgical Patients." Dr. E. Starr Judd, an alumnus of the Medical School of the University of Minnesota, established this annual lecture-ship in surgery a few years before his death.

POSITIONS paying \$4,600 a year in the Bureau of Plant Industry of the Department of Agriculture will be filled from a civil-service examination for floriculturists, olericulturists and plant pathologists. A written test will not be given, but applicants will be rated on their education and experience. These are "research" positions involving the supervision of assistants and the preparation of manuscripts for publication as well as the handling of technical correspondence. Applicants must have completed a 4-year college course with major study in biological science, and must have had responsible research experience, although for part of this experience certain graduate study may be utilized. Those interested in these positions are urged to look upon them as the beginning of a career in the government service. Applications must be on file with the U. S. Civil Service Commission at Washington, D. C., not later than January 3, 1942.

THE Bloede Scholarship of the Chemists' Club is available for the year 1942-43. Applications will be received beginning on January 1 and closing on March 1. This scholarship is awarded in alternate years and provides a stipend of \$580, payable in semi-annual instalments. Candidates are limited to men entering their last year of post-graduate work leading to the Ph.D. degree in chemistry or chemical engineering in an institution of recognized standing. Application

blanks may be obtained after January 1 from the Secretary, the Chemists' Club, 52 East 41st Street, New York, N. Y.

THE annual meeting of the History of Science Society will be held at Chicago in conjunction with the American Historical Association on December 30 and 31.

BECAUSE of the large amount of work being done by the National Academy of Sciences and National Research Council committees in an advisory capacity to the government during the present emergency, and because exhibit and other rooms formerly open to the public are now occupied as offices, the Council of the National Academy of Sciences has directed that the National Academy of Sciences Building be closed to the public until further notice. The National Academy of Sciences regrets that this step is necessary, but will, as soon as circumstances permit, reinstall exhibits of scientific interest to the public. The 1942 annual meeting of the academy will be held in the academy building as usual (April 27, 28, 29); but attendance at the scientific sessions will be limited to academy members, their invited guests, the press and to non-members who present papers before the academy. Hitherto these sessions have been open to the general public. It is regretted that programs, as well as abstracts of the papers, will be available only to members of the academy and to the press.

WITH a view toward serving not only the needs of the present emergency, but also those of future reconstruction and development, it is now planned to integrate the activities of the past few years at New York University by establishing an Institute for Applied Mathematics.

THE Kansas City-Western Dental College has been merged with the University of Kansas City. Dean Roy J. Rinehart will continue as administrative head and will also serve on the advisory council of the University Board of Trustees.

AN Associated Press dispatch reports that the Vichy Government has announced the establishment of the Alexis Carrel Foundation for Study of Human Problems, under the direction of Dr. Carrel. Dr. Carrel went to France on March 15 to make a study of the physical effects of blockade conditions and malnutrition, and has since been living in the occupied zone.

THE organization of a research foundation by the Alumni Association of the University of Washington to aid in scientific investigation and in the application of the results of research in the development of the state has been approved by the Board of Regents of the university. The organization, which will be

incorporated as an independent and non-profit foundation, will be a corporation working in close harmony with the university but managed by a board of eleven trustees. Under the incorporation the foundation will be able to receive all types of bequests, gifts, assignments of patents, royalties, etc. It will be a business corporation so far as contracts, trust agreements, licenses and buying and selling are concerned.

*The News Edition* of the American Chemical Society states that the National Aniline and Chemical Company, a subsidiary of Allied Chemical and Dye Corporation, New York, is being merged with the parent company. Its business will be conducted as the National Aniline and Chemical Division of the Allied Chemical and Dye Corporation. B. A. Ludwig, president of National Aniline, and E. W. Clark, president of the Barrett Company, another subsidiary, have been appointed vice-presidents of Allied Chemical and Dye Corporation.

THE RCA electron microscope has been adjudged the winner in a Products Design contest entered by hundreds of American manufacturers which was conducted by *Electrical Manufacturing* on the grounds of its basic design and its outstanding external appearance, and a descriptive "Award Paper" prepared by Theodore A. Smith, of the RCA Engineering Products Division.

It is reported in *The British Medical Journal* that at the suggestion of Dr. G. Jedlewski, medical adviser to M. Raczkiewicz, the Polish President, a special medical board has been formed in London to prepare

plans for fighting epidemics which may break out in Poland at the end of the war, and thus to prevent the spread of infectious disease to Western Europe and Great Britain. The board, acting in conjunction with the Ministry of Health, will also collect medical supplies so that immediate help may be ready at the end of the war.

A UNITED PRESS dispatch from Berlin dated December 3 reads: "Reports from Berlin said that the University of Brussels had begun a sit-down strike against German occupation authorities and that the Germans had served an ultimatum ordering the faculty to reopen the school to-morrow 'or take the consequences.' The trouble, according to the *Brüsseler Zeitung*, began when the Germans ordered eighteen Flemish professors put on the staff, which had been entirely French. University authorities objected to three of the Germans' candidates, one of whom the newspaper described as 'a Flemish activist in the World War period.' The other two were said to be strongly pro-German."

It is stated in *The New York Times* that filming of a documentary motion picture on nutrition has been started in Hollywood under the sponsorship of Paul V. McNutt, Federal Security Administrator. The film is a project of the Office of Defense Health and Welfare Services and is being produced by the American Film Center which is supported by the Rockefeller Foundation.

A GRANT of \$50,000 has been made by the Commonwealth Fund to the American Bureau for Medical Aid to China, for the support of the Emergency Medical Service Training School in Kweiyang, China.

## DISCUSSION

### THE ROLE OF THE BURROWING OWL AND THE STICKTIGHT FLEA IN THE SPREAD OF PLAGUE

DURING the spring and summer of 1941 a study was made of a plague epizootic then in progress among the ground squirrels (*Citellus beecheyi*) to the east and south of Bakersfield, Kern County, California. Proof of the identity of the disease was obtained by the isolation of *Pasteurella pestis* from the tissues of infected squirrels as well as from various species of flea found on the rodent hosts. From an epidemiological point of view the possible methods of spread of the disease are of particular interest, and in this connection the following sequence of facts is considered worthy of special notice.

(1) In this epizootic, which was discovered by a survey crew of the California State Department of Public Health, the first squirrel to be proven plague-infected was obtained on April 29, 1941, on the El

Tejon ranch, at a spot about twelve miles due east of Wheeler Ridge. The outbreak was evidently nearing the close of its active phase in this area, for no infected animals were found here after May 1, but the infection appeared to linger on in the flea population, for fleas obtained from squirrels as late as May 15 still had living plague organisms in their digestive tracts.

(2) Among the fleas collected from ground squirrels in near-by areas were specimens of the sticktight flea (*Echidnophaga gallinacea*), a species of extremely wide geographical and hostal occurrence in the United States. It is found abundantly on chickens and other domestic fowl, on rats and various wild rodents, and on such predators as the coyote, Cooper's hawk and burrowing owl.<sup>1,2</sup> The last-man-

<sup>1</sup> I. Fox, "Fleas of Eastern United States," Iowa State College Press, Ames, Iowa, 11-12, 1940.

tioned of these hosts, the burrowing owl (*Speotyto cunicularia*), was seen frequently at low altitudes in areas where the plague epizootic was in force. The association of burrowing owls with colonies of ground squirrels is a well-known fact, and the obvious possibilities of contact between them need hardly be mentioned.

(3) On June 28, 1941, a specimen of the burrowing owl taken on the El Tejon ranch about five miles west of the plague area yielded 70 individuals of *E. gallinacea*, which upon mass-inoculation into a test guinea pig proved to be infected with plague organisms. A post-mortem examination of the owl could not be made at the time, but the possibility that this bird was the source of infection for these particular fleas seems remote, as it is generally agreed that birds are not susceptible to plague. This is apparently the first record of a bird host as a carrier of plague-infected parasites, and the first demonstration of natural plague infection in this species of flea. Experiments are now in progress to determine the vector efficiency<sup>3</sup> of this flea.

As long ago as 1909 Rucker<sup>4</sup> suggested that the burrowing owl might play an important part in the dissemination of plague as a carrier of infected fleas, but his remarks were not supported by any direct evidence. More recently Jellison<sup>5</sup> has discussed the rôle of predatory birds in the spread of plague and has shown that rodent fleas of various species are frequently transported on freshly killed hosts to the nests; however, in no instance was the presence of plague established. The fact that plague has now been isolated from a species of flea common to both rodent and bird hosts, and from specimens actually obtained from a bird, finally lends supportive evidence to an old theory and adds another complicating factor to the epidemiology of plague.

C. M. WHEELER  
J. R. DOUGLAS  
F. C. EVANS

GEORGE WILLIAMS HOOPER FOUNDATION,  
UNIVERSITY OF CALIFORNIA,  
SAN FRANCISCO

### THE TERM "EUTHENICS"

WHEN the charter for the establishment of the Iowa Child Welfare Research Station was prepared, I was

in favor of using the term "euthenics," defined in Webster's dictionary as "the science having to do with the betterment of living conditions to secure more efficient human beings," as a term coordinate with the term "eugenics." In common language, eugenics would then denote the science and art of being well born, and euthenics the science and art of living well or wise living. This would have been very appropriate, but at that time we had to win the popular approval of the legislature and the people of the state so we fell back on the easily understood term "child welfare" and gave it a new connotation by centering it upon scientific research. Now that child welfare or child development is a well-established movement, both theoretical and practical, I would again advocate the use of the single technical word euthenics to denote scientific procedures within this great area.

We may speak appropriately of the science of euthenics or the art of euthenics depending upon the point of view. In the former case, the question arises as to whether there is or can be such a science of well-being. We immediately recognize that practically all the sciences contribute to this subject, as in medicine, engineering, economics, psychology, physiology, sociology and education. The question then arises: Can the salient interests and contributions from each of the sciences be selected and coordinated into a specific applied science? Likewise we may ask: Can we recognize a definable and significant area to be designated as the art of well-being? It is well recognized that such applied arts as education, sociology and mental and physical, individual and social hygiene center about this issue. The question then arises: Can the salient interests and contributions from all such sources be selected and coordinated into a specific applied art? On both of these issues, the time would now seem ripe to recognize an affirmative answer.

In other fields the term "psychology" is made to function, as in the psychology of music, the psychology of art, the psychology of speech, the psychology of dramatics, the psychology of athletics or the psychology of advertising. This terminology is justified on the ground that it is the function of psychology as a science of experience and behavior to select, integrate, organize and foster interests developed in all other sciences pertaining to the subject and to take the initiative for the conduct of research within these specific fields of applied science. The term "psychology of music" has the advantage of having made the best contacts with musical education and other musical enterprises. Within one year four textbooks under the same title, "The Psychology of Music" were published. That term has gained full recognition as a coordinator of all the scientific approaches to the

<sup>1</sup> M. A. Stewart, *Jour. Econ. Entom.*, 25: 165, 1932.

<sup>2</sup> C. M. Wheeler and J. R. Douglas, *Proceedings, Soc. Exp. Biol. and Med.*, 47: 65-66, 1941.

<sup>3</sup> W. C. Rucker, *U. S. Public Health Reports*, 24: 1225-1238, 1909.

<sup>5</sup> W. L. Jellison, *U. S. Public Health Reports*, 54: 792-798, 1939.

theory and practice of music. On this analogy we might speak of the psychology of child welfare or the psychology of child development. But this would hardly be appropriate in view of the large number of strong independent trends in other sciences within this field.

There is still another analogy which is illustrated by the term "musicology," which is now coming into use to designate all scientific approaches to the science of music. It already claims a number of distinct fields, such as the history of music, the theory of music, musical anthropology, the science of composition, phonetics and acoustics. Can euthenics be thus recognized as a comprehensive term within which a number of specific areas may function?

The term "eugenics" is now well established for both scientific and practical purposes as the science of being well born. This is a happy term and defines adequately one specific area in the immensely larger field of genetics. It is generally restricted to this one aspect of human genetics. It would be well if we could establish a term which would be an exact companion piece to denote the area of the development of well-being. The term "euthenics" seems to meet all the requirements for this.

Within the area of eugenics we recognize various segments; such as individual eugenics and racial eugenics, and various areas pertaining to controlling factors; such as eugenic birth control, eugenic climate and eugenic legislation: so in euthenics we might recognize logical divisions, such as child euthenics, adult euthenics and racial euthenics; and various areas pertaining to causal factors, such as medical euthenics, ethical euthenics and legislative euthenics. For all such purposes such terms as child welfare and child well-being would seem to be partial, inadequate and cumbersome.

As we make satisfactory distinctions between theoretical, experimental and practical eugenics, so we might to great advantage distinguish between theoretical, experimental and practical euthenics. A relatively new term such as this is something of a red rag because it is new. But like the child who takes pleasure in pronouncing long words, the educated public would soon recognize the appropriateness of the derivation of this word and quickly give it a place in the language of daily life to designate a field of universal human interest.

The adoption of this technical term would not discourage the continued use of such terms as child guidance, child welfare and child development, but would tend to give each such term a more specific connotation.

As in eugenics a person who is devoted to that science is spoken of as a *eugenicist*, it would be con-

venient to have in the field of euthenics the provisional designation *euthenicist*. We would hardly think of calling such a person a child developer. The listing of eugenics in the university catalogue might have some advantage over the present practices without any sacrifice of present interests. It would be advantageous to have such a technical term in the various rosters of the sciences.

As indicated above, the moment for the establishment of the mother institution of child welfare research stations was not a propitious moment for reinforcing the term "euthenics," but may it not be that the present time is the psychological moment to clarify the issue in the light of the extraordinarily rich experience gained within this field in the last twenty-five years? Scientists can look at the situation in an entirely different light now than they could before that movement began to crystallize.

And may we not also find it useful to distinguish between the science of euthenics and the art of euthenics? Each of these two distinct points of view is now clearly on the horizon as a fascinating, mandatory and profitable field of research which may be well centered and clarified in the interest of the theory and practice of wise living.

CARL E. SEASHORE

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### ONE UNUSUAL OBSERVATION IN THE AURORAL DISPLAY OF SEPTEMBER 18

RECENTLY in discussing the auroral display of September 18 last with Dr. Harlan T. Stetson, I called attention to the amazing nearness of the overhead streamers at one time. Dr. Stetson explained that such an observation was not likely to be accepted, perhaps because of the nature and method of production of the streamers.

I am therefore making this belated record of certain of my observations on September 18. The observations were made near and about Bexley Hall, 50 Massachusetts Avenue, Cambridge.

The streamers were first observed somewhat after 8 P.M. At this time there were two quiet streamers in the north slightly to the west. These seemed to connect near the zenith with a searchlight beam emanating in Boston. Shortly the streamers began to cut capers, first by blinking on and off. From then until near midnight several distinct phenomena were seen. (I will not discuss the curtain of colored light which appeared so beautifully twice above the northern horizon, because there is nothing unusual to report, and in attempting such might disclose disqualification for reporting on the apparent nearness of the streamers at one time.)

Some of the general observations are as follows:

The number of the streamers varied in number from one to four, and usually terminated near the zenith. Sometimes they would pop on or off suddenly. Other times they would change from one state to another very slowly. Sometimes they would be blinking like stationary waves. Many times they appeared as moving waves of light, going from north toward the zenith. At irregular intervals the apparent distance of the streamers varied. They always appeared near in comparison with the northern curtain. The maximum distance never seemed more than forty miles, and several times seemed closer than cumulus clouds. The one observation that has stood out was made a little after 10 P.M. The one mass streamer seemed to be only twenty or thirty feet above my head. It was moving as waves in the general direction of Massachusetts Avenue toward Boston. It reminded me of fine particles of snow moving in a severe wind, as in a blizzard, when the snow is illuminated by a beam of light. The waves seemed to have much depth, as do

the waves of moving snow in a blizzard. Nothing was visible beyond.

C. J. Taylor, of the Radiation Laboratory, Massachusetts Institute of Technology, made substantially the same observations from the roof of the Massachusetts Institute of Technology. While he was some fifty feet higher, the moving streamers were about the same distance above his head as they were above mine.

S. F. West reports that he observed the moving streamers or moving flashes of light to be barely over his head at about 10:30 on that evening. His observations were made on the roof of the Massachusetts Institute of Technology. It should be added that throughout the evening and night a very destructive fire was burning at Charlestown about two miles away. It is barely possible that the wind may have carried ionized air over our observation posts for a short interval. In general, however, the direction of the wind was toward Boston.

F. C. BROWN

## QUOTATIONS

### CHEMISTS AND THE NATIONAL DEFENSE

IN recent months many members of the American Chemical Society have expressed a desire to take an active part in the program of national defense. The number of letters which have been received by various officials in Washington from chemists all over the country offering their services to the Government is a clear manifestation of the great desire of the members of our profession to do their part in the present gigantic task of rearmament. Unfortunately, in many cases it has not been possible to take advantage of the talent thus offered. This is a physicist's war rather than a chemist's. For the present, at least, there appear to be more investigations of a physical nature than there are chemical military problems. But the situation may at any moment change rapidly. It is well to have a reservoir of research capacity in our colleges, universities, consulting laboratories and research institutes. It may not be long before this reservoir will be heavily drawn upon for tasks directly concerned with defense problems. And in the meantime it is of vital importance to the nation that our educational institutions continue to train young chemists and chemical engineers. Chemists in industry are, of course, engaged in work which almost without exception is in one way or another an integral part of the total defense activities of the country. More young men will be required every month for these tasks. Every teacher of chemistry, whether or not he is carrying on research for the Government, is playing an important part in the rearmament program of the nation.

Although physicists and electrical engineers rather than chemists are concerned with the most pressing research and development problems of the Army and the Navy, this does not mean there is no chemical work in progress. Quite the contrary. Both the Army and the Navy for years have maintained chemical laboratories where investigations are conducted on explosives, chemical warfare and a multitude of miscellaneous problems. In this period of unlimited national emergency, the work of these governmental laboratories must needs be supplemented. And to this end a number of chemists in universities and industrial laboratories have been called upon to assist. To some extent this has been done directly by the services, but to a large measure the task of assisting the scientific personnel of the armed forces has been the responsibility of the National Defense Research Committee. The effort has been to distribute the work as far as possible to a good many different laboratories and to draw on all branches of our profession. More than half the starred chemists in "American Men of Science" are now involved in one way or another in work pertaining directly to the national defense program.

The NDRC was created by presidential order in June, 1940. It came into being at a time when the shock of the fall of France had galvanized this country into action. The need for haste in the rearmament program was apparent to all. Industry was being called upon to perform miracles of speedy readjustment and expansion. A mobilization of scientific talent was evidently also a first order of the day. What was clearly needed was not another advisory

body, for the National Research Council was already functioning admirably in this respect, but an executive agency to assist the Army and the Navy by organizing the scientific reserve power of the country and putting it to work on those problems deemed most vital by the members of the armed forces. To this end, the committee was supplied with funds and given authority to enter into contracts with research institutions, both academic and commercial, for the prosecution of research under suitable conditions of secrecy.

Vannevar Bush, president of the Carnegie Institution of Washington, was appointed chairman. The Secretary of War and the Secretary of the Navy were each represented on the committee by high-ranking officers. In addition, many other officers were designated for liaison purposes on special problems. Through these channels we soon discovered in broad outline the nature of the most urgent matters that required scientific investigation. The civilian members of the committee divided up the work. To my lot fell chemistry; to President Compton of M. I. T. was assigned one branch of physics; to Frank B. Jewett, another; to Richard C. Tolman, of California Institute of Technology, a third aspect of physical investigation. Each of these divisions soon organized sections or subcommittees, each dealing with special problems.

My first act as chairman of the Chemical Division was to have Roger Adams and W. K. Lewis appointed vice-chairmen to organize two separate phases of the work. Needless to say, elaborate precautions were necessary to ensure secrecy. We were asked to sit down as partners with the scientists and engineers of the Army and the Navy and to share their secrets. Therefore, we saw to it that in every way we were as careful with our confidential information as the armed services themselves.

Unfortunately, the very secrecy to which I have just referred prevents my making this brief article interesting. Instead of listing the extremely interesting and highly important problems we have been called upon to solve, a writer on this subject must have recourse to dull statistics. During the first year of its existence, the National Defense Research Committee spent approximately \$10,000,000 through 270 contracts placed in 47 different universities, technical schools and research laboratories; and 153 contracts placed with 39 industrial firms. Nearly 2,000 scientists are at work under these contracts and approximately the same number of technicians and assistants.

Last June an Executive Order created the Office of Scientific Research and Development with Vannevar Bush as director. In his new capacity Dr. Bush was charged not only with many of his former responsi-

bilities as chairman of NDRC but with the further task of coordinating research on medical problems affecting national defense. And most important of all, he has charge of coordinating and, where desirable, supplementing the scientific research activities for defense carried on by the Departments of War and Navy and other agencies of the Federal Government. The NDRC now becomes a part of the new Office of Scientific Research and Development and I, as the new chairman, am responsible to Dr. Bush. Roger Adams has become a member of the NDRC and is in charge of all the work of the chemists.

A new Medical Research Committee of which A. N. Richards is chairman has been formed. The other members of this committee are L. H. Weed, A. R. Dochez, A. B. Hastings and representatives of the Surgeon General of the Army, of the Navy and of Public Health. Irvin Stewart is Executive Secretary of this committee, as well as of the NDRC and of the OSRD. This committee, which parallels the NDRC, is concerned with problems of medical research. On a scientific advisory council to the Director of the Office of Scientific Research and Development sits the chairman of this committee, the chairman of the NDRC, the chairman of the National Advisory Committee on Aeronautics and the coordinators of research of the Army and Navy. The Office of Scientific Research and Development maintains close connections with the National Research Council and its many sections and committees.

Since the work of the NDRC is concerned solely with research and development on instrumentalities of war, there are many chemical problems of national importance which lie outside its province. Some of these are clearly within the field of operation of the new Medical Research Committee, while others are the concern of the National Research Council and its agencies.

Many chemists have been asked to cooperate in the national defense program through the Chemistry Section of the council, and especially in the field of biochemistry through the Medical Research Committee and the committees of the council with which its work is closely associated. Undoubtedly there will be an expansion in this direction as well as in the work of the Chemical Division of the NDRC and gradually a still greater number of research chemists will be asked to play a part in the ever-increasing national defense effort. To those who have given freely of their time and talents, the country owes a debt of gratitude.—*James B. Conant, president of Harvard University, chairman of the National Defense Research Committee, in the News Edition of the American Chemical Society.*

## SCIENTIFIC BOOKS

## INDUSTRIAL POISONS

*Analytical Chemistry of Industrial Poisons, Hazards, and Solvents.* By M. B. JACOBS. New York: Interscience Publishers, Incorporated, 1941. Price, \$7.00.

THE tremendous increase in defense production, which includes all types of industrial work, makes the appearance of this type of book a timely one. Few works to date have compiled such chemical studies. Its completeness makes it of great value for the increasing number of medical men, toxicologists, industrial hygienists and chemists coming into contact with these problems.

The contents of the book are quite thoroughly covered by references, some 1,200 in all. The table of contents and subject and author indexes make it possible to locate subject matter quickly.

The appendix, giving a tabular estimation of parts per million and milligrams per liter from molecular weights, is of special value. It also lists limits of inflammability and explosive ranges of industrial compounds; acute physiological responses to gases and vapors; probable safe concentration limits of exposure for vapors, gases, dusts, fumes and smokes according to various codes; minimum lethal doses for a number of lacrymators, lung irritants, vesicants, other war gases, etc.

Analytical methods or reference to methods for the various known compounds used or produced in industry are outlined. In addition to giving chemical methods, sampling equipment and procedures, and gas volume and velocity measurements are described.

The book gives a brief, but very helpful, pharmacological and toxicological consideration of the various compounds.

The book is well written and has a minimum of typographical errors. It is the reviewer's opinion

that the price of the book, unfortunately, makes it somewhat prohibitive for the body of individuals who could reap most benefit from its use.

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## ALGEBRA

*Algebra.* By W. L. FERRAR. vi + 202 pp. Oxford: Clarendon Press. 1941.

THIS book was written to provide a text, principally for university undergraduates, on determinants, matrices and algebraic forms. The only prerequisite training required is that provided by the usual course in college algebra, and thus the author's Part I consists of a 59-page presentation of the classical theory of determinants. Part II, on the theory of matrices of complex numbers, presents in 52 pages the elementary matrix concepts, the notions of characteristic function and latent root, the definitions of elementary transformations over a number field  $F$ , and the theory of equivalence of rectangular matrices over  $F$ . The final part consists of 49 pages on real quadratic forms and 30 pages on invariants and covariants. The omission of the theory of similarity of square matrices is rather curious in a text presenting the theory of equivalence of pairs of real quadratic forms.

The author's sources include no modern treatment of his subject, and this probably accounts for his use of so much obsolete terminology. He states that his omission of any hint of abstract algebra is deliberate, but misses the point that even an elementary exposition of the theory of matrices with complex elements could profit by the adoption of the streamlining of the modern versions.

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## SOCIETIES AND MEETINGS

## THE INDIANA ACADEMY OF SCIENCE

THE fifty-seventh annual meeting of the Indiana Academy of Science was held at DePauw University, Greencastle, Indiana, on October 30 and 31 and November 1. Over five hundred scientists from Indiana and Ohio were in attendance, including sixteen past presidents of the academy. The executive committee met on Thursday evening, after which President Paul Weatherwax, Indiana University, made a radio broadcast on "The History and Objectives of the Indiana Academy of Science." The general sessions opened on Friday morning with an address of

welcome by President Clyde E. Wildman, of DePauw University, which was followed by a response by President Weatherwax. After a short business session a brief memorial service was held for the eleven members of the academy who had died since the last meeting. Among these eleven were William Albert Noyes, Frank M. Andrews, Charles B. Jordan, Arthur E. Haas, Clinton A. Ludwig and James Troop. The principal addresses of the general session were given by Arthur L. Foley, Indiana University, on "Why? What? Whither?" and Arthur T. Evans, Miami University, on "Some Thoughts on Origin and Evolution."

Friday afternoon was devoted to division meetings, at which about eighty papers were read and discussed. Also the new Psychological Laboratory of DePauw University was dedicated with an address by Archie G. Bills, of the University of Cincinnati.

The annual dinner was held on Friday evening with one hundred fifty in attendance after which the president's address was given by Paul Weatherwax, Indiana University, on "The Indian as a Corn Breeder." The following officers were then chosen for the coming year: *President*, M. G. Mellon, Purdue University; *Vice-president*, Theodore Just, Notre Dame University; *Secretary*, Winona H. Welch, DePauw University; *Treasurer*, William P. Morgun, Indiana Central College; *Editor of the Proceedings*, P. D. Edwards, Ball State Teachers College; *Press Secretary*, C. M. Palmer, Butler University; *Member of Research Grant Committee*, A. L. Foley, Indiana University; *Division Chairmen*: Archeology, C. F. Voegelin, Indiana University; Bacteriology, L. S. McClung, Indiana University; Botany, Ray C. Friesner, Butler University; Chemistry, K. N. Campbell, Notre Dame University; Geology and Geography, G. T. Wickwire, Hanover College; Mathematics, Will E. Edington, DePauw University; Physics, O. H. Smith, DePauw University; Zoology, T. M. Sonneborn, Indiana University. J. L. Riebsomer, DePauw University, was elected a fellow of the academy.

Saturday was devoted to meetings of the Indiana Society of Taxonomists under the chairmanship of M. S. Markle, Earlham College, and the Indiana Society of Entomologists, with George E. Gould, Purdue University, as chairman.

The Junior Academy of Science, composed of forty high-school science clubs, also held its meetings and exhibits on Saturday under the sponsorship of Howard E. Enders, Purdue University. About three hundred high-school students and teachers were in attendance and a number of papers were presented on their program. A special feature was a lecture and demonstration of liquid air by F. J. Allen, Purdue University. The following officers were chosen for 1942: *President*, James Sarasic, Elmhurst High School, Fort Wayne; *Vice-president*, Jack Moseley, Greencastle High School; *Secretary*, Selma Heaton, Mishawaka High School. Honorary memberships in the American Association for the Advancement of Science were awarded to Don Courtney, Sullivan High School, and Jean Ross, Hammond High School.

The next annual meeting of the academy and the junior academy will be held at Notre Dame University as a part of the Centennial Celebration of that university.

WILL E. EDINGTON,  
*Press Secretary*

DEPAUW UNIVERSITY

## SPECIAL ARTICLES

### EXPERIMENTAL AIR-BORNE INFECTION WITH POLIOMYELITIS VIRUS<sup>1</sup>

THE work of W. F. Wells and his associates<sup>2</sup> has shown the importance of transmission of both bacterial and virus infections by dried droplet nuclei, such as are formed by evaporation in the air of moist droplets expelled from the nose and mouth. These minute nuclei remain suspended in air for considerable periods of time, during which they constitute a potential source of infection by inhalation. As far as we are aware, the possibility of poliomyelitis being transmitted in this manner has never been put to experimental test, probably because the apparatus and technique developed by Wells have not been widely available. During the past year we have constructed an apparatus based on that of Wells<sup>3</sup> but modified in some respects, with which we have made a number

of experiments and obtained some positive results. These, we believe, justify a preliminary report.

**Apparatus.** The infecting chamber consists of a Monel metal box 18" × 18" × 24" with four port holes with rubber diaphragms through which the heads of the monkeys are inserted. The atomizing apparatus used in the first two series (32 monkeys) was found to give a poor delivery of material into the infecting chamber and was replaced by a better one designed for us by Mr. F. H. Osborn of this city. Compressed air mixed with 5-10 per cent. CO<sub>2</sub> (to increase the depth of respiration) was passed through a flow meter into the atomizer at an average rate of about 6.6 liters per minute, run continuously throughout each experiment. Test runs with suspensions of *Chr. prodigiosum* showed an even distribution of colonies on plates placed in the position later occupied by the animals' heads—evidence of satisfactory formation and dispersion of droplet nuclei and absence of large, moist droplets.

**Animals used.** A total of 48 rhesus monkeys (*M. mulatta*) and of 13 cynomolgus monkeys (*M. irus*) have been exposed. Of these, 31 rhesus and 6 cyno-

<sup>1</sup> From the Department of Pediatrics, Stanford University School of Medicine, San Francisco, California. Sponsored by the National Foundation for Infantile Paralysis, Inc.

<sup>2</sup> (a) W. F. Wells, *Am. Jour. Hyg.*, 20: 611, 1934. (b) W. F. Wells and H. W. Brown, *Am. Jour. Hyg.*, 24: 407, 1936. (c) W. F. Wells and M. W. Wells, *Jour. Am. Med. Assn.*, 107: 1698 and 1805, 1936.

<sup>3</sup> W. F. Wells, *SCIENCE*, 91: 172, 1940.

molgus were subjected to preliminary blockade of the olfactory mucosa with 1 per cent. zinc sulfate solution; and 16 rhesus and 7 cynomolgus were not so treated.

**Virus used.** The first tests were made with the old MV strain (mixed with the Armstrong strain), kindly supplied by Dr. E. W. Schultz. All other tests in rhesus were made with the O-H strain in the second and third passages (kindly supplied by Dr. James D. Trask). The tests with cynomolgus were made with a recently isolated strain (designated Sab) in the sixth and eighth passages, kindly supplied by Dr. Albert F. Sabin. Supernatant fluid from 20 per cent. suspension of cord was used in amounts varying from 25 to 85 cc for each series of monkeys; the maximum amount available to each monkey based on an assumed even dispersion of nuclei, ranged from 1.6 to 12.1 cc. The actual amount inhaled can not at present be estimated, but was undoubtedly much less than this, since much of the virus in the air must have been evacuated through the exhaust outlet.

The animals, under nembutal anesthesia, were exposed in groups, usually of four, for individual periods of 1-2 hours; repeated in some instances on two or three successive days.

The experiments and the results obtained are summarized in Table 1.

cynomolgus monkeys in which the olfactory mucosa was not treated with zinc sulphate, six developed poliomyelitis proved by typical histological lesions. The seventh, which escaped, had a severe diarrhea for four weeks after exposure. A fairly uniform symptomatic pattern occurred in all the positive cases of the last series: fever at 4 to 7 days after exposure, followed by tremors and varying amounts of weakness or paralysis, the latter in all cases being in the extremities without apparent involvement of the cranial nerves. Examination of serial sections of the olfactory bulbs showed lesions in all; but in at least two of the cases, these were superficial and slight and no destruction of the mitral cells was found. Such lesions resemble those described by Howe and Bodian<sup>4</sup> in some of their human cases, in which the writers felt that the lesions were secondary rather than primary and probably not indicative of entry through the olfactory portal.

In 4 rhesus monkeys with, and in 4 rhesus without olfactory blockade, transient rises of temperature occurred from 6 to 17 days after exposure, without other evidences of infection except in a few of mild malaise, tremors or ruffling of the fur. One of these was killed; subinoculations from various parts of the central nervous system were all negative; histological examination showed no cellular infiltrations or neur-

TABLE 1

Series	Virus	Total number	Olfactory blockade				No olfactory blockade				Exposure			
			Number	Polio	No Polio	Fever	Number	Polio	No Polio	Fever	Number	Total hours	Total virus cc	Virus per monkey cc
Rh I	MVA	16	8	0	8	0	8	0	7	1	1	1	25	1.6
Rh II	O-H <sup>a</sup>	16	8	0	8	0	8	0	5	3	1	1	37	2.3
Rh III	O-H <sup>a</sup>	8	8	1	4	3	..	..	..	..	3	3	75	9.4
Rh IV	O-H <sup>a</sup>	8*	8	1	5	1	..	..	..	..	2	3	75	9.4
Total rhesus		48	32	2	25	4	16	0	12	4	2	2	85	12.1
Cyn I	Sab <sup>a</sup>	7	..	..	..	..	7	6	1	0	2	2	85	12.1
Cyn II	Sab <sup>a</sup>	6	6	2	4	0	..	..	..	..	1	2	40	6.7
Total cyno- molgus		13	6	2	4	0	7	6	1	0				

\* One monkey killed immediately after exposure.

In all, up to the present time, 10 monkeys of the 60 tested have developed typical poliomyelitis, proved by the presence of typical lesions, by subinoculation, or by both. Of these, four had had olfactory blockade and six had not. Of the four with olfactory blockade, two were rhesus and two were cynomolgus. In the positive rhesus experiments, weakness first appeared in the legs, on the seventeenth and eighth days after exposure, respectively, and no bulbar disturbances were observed. The incubation periods in both cynomolgus monkeys were 11 and 14 days to the appearance of paralytic signs. One of these had right facial paralysis and some respiratory difficulty. The other had severe respiratory difficulty, probably of the central type, but no other paralyses. Of seven

onophagia; in the anterior horns at various levels of the cord, a rather marked satellitosis was noted and a number of ganglion cells showed vacuolization of the cytoplasm. The significance of these changes is not clear. The fever and occasional slight symptoms, however, suggest an abortive type of the disease which can not at present be considered as proved. More complete histological examinations are in progress.

We feel that the successful infection of two rhesus monkeys by inhalation has a special significance in relation to the portal of entry. The olfactory route in both was excluded by the previous blockade of the olfactory mucosa with zinc sulfate and by the

<sup>4</sup>H. A. Howe and D. Bodian, *Bull. Johns Hopkins Hosp.*, 69: 183, 1941.

absence of lesions in the olfactory bulbs as determined by serial sections. The oropharyngeal and gastrointestinal routes can also, in all probability, be considered as excluded on the basis of general experience with the rhesus monkey extending over more than thirty years during which it has been the standard test animal in poliomyelitis research, showing that animals of that species can only be infected non-traumatically by the olfactory route. Several extensive studies, of which those of Clark, Roberts and Preston<sup>5</sup> and of Flexner<sup>6</sup> may be cited, testify to the uniformly negative results of feeding virus to rhesus. It therefore seems highly probable that in the positive inhalation experiments with rhesus here reported, infection entered through the lower respiratory mucosa, at or below the epiglottis. The character of the symptoms in the two positive cynomolgus experiments with olfactory blockade, on the other hand, suggest entry through the oropharynx.

Further work along the same lines is in progress.

#### SUMMARY

Infection has been obtained in both rhesus and cynomolgus monkeys by inhalation of poliomyelitis virus in the form of droplet nuclei. The olfactory route was excluded in part of the animals successfully infected. The gastrointestinal route is believed to have been excluded in the rhesus monkeys. It seems most probable that the portals of entry were the lower respiratory mucosa in the case of the rhesus monkeys and the oropharyngeal mucosa in the case of the cynomolgus monkeys. Fever and occasional mild symptoms in 8 other rhesus monkeys suggest that an abortive form of poliomyelitis may have resulted from inhalation, but this can not at present be considered as proved. The experiments open up the possibility that human poliomyelitis may, at least sometimes, be an air-borne infection and that the lungs may be a portal of entry. Neither of these aspects of the disease has hitherto, so far as we are aware, been studied experimentally. The presence of virus in the human nasopharynx, which has been repeatedly demonstrated,<sup>7, 8</sup> provides an obvious source of air contamination by patients and carriers; and direct contact has been traced during epidemics in a considerable fraction of cases,<sup>9</sup> amounting to about one third in the report of Top and Vaughan.<sup>10</sup> The

relative importance of transmission by air and by ingested material remains to be determined. It would seem probable, however, that both modes of infection must be taken into account.

HAROLD K. FABER

ROSALIE J. SILVERBERG

#### INHIBITORY EFFECTS OF SULFONAMIDES ON CULTURES OF ACTINOMYCES HOMINIS<sup>1</sup>

PRACTICALLY no information is available on the possible effects of *in vitro* sulfonamides on fungi, although there have been several reports of clinical benefits from the use of sulfonamide drugs in fungous infections.<sup>2</sup> This has resulted in an uncertainty as to whether the effect of the sulfonamides is on the fungi themselves or on secondary bacterial invaders. This paper reports the demonstration of direct inhibitory effects of sulfonamide drugs on cultures of *Actinomyces hominis*.

A stock strain (S) of *Actinomyces hominis* was cultured on Krainsky's glucose agar, and thioglycollate medium.<sup>3</sup> Another strain (M) was isolated on the thioglycollate medium from a draining sinus from the jaw of a patient and thereafter grown on veal agar medium. It differed from the former strain in that the organisms were shorter, seldom branched and often clubbed. The following drugs and concentrations were used: sulfanilamide, sulfathiazole and sulfadiazine,<sup>4</sup> in concentrations of 10, 50 and 100 mg per cent. incorporated in the media before autoclaving. The results obtained may be summarized according to aerobic and anaerobic conditions.

#### AEROBIC CONDITIONS

The S strain grown aerobically on Krainsky's medium was delayed in growth by concentrations of sulfanilamide of 10 and 50 mg per cent. but at the end of one month the growth in both concentrations equalled that of the controls (10 cultures). A concentration of 100 mg per cent., however, completely inhibited growth in some instances and allowed only slight growth in others by the end of one month (7 cultures). Sulfathiazole allowed moderate growth in 10 mg per cent. concentration, slight growth in 50 mg per cent. concentration, and no growth in 100 mg per cent. concentration (9 cultures). The observations in each case extended over one month. The results with

<sup>5</sup> P. F. Clark, D. J. Roberts and W. S. Preston, *Jour. Prev. Med.*, 6: 47, 1932.

<sup>6</sup> S. Flexner, *Jour. Exp. Med.*, 63: 157, 1936.

<sup>7</sup> S. D. Kramer, B. Hoskwith and L. H. Grossman, *Jour. Exp. Med.*, 69: 49, 1939.

<sup>8</sup> A. B. Sabin and R. Ward, *Jour. Exp. Med.*, 73: 771, 1941.

<sup>9</sup> Survey by International Committee for the Study of Infantile Paralysis Organized by Jeremiah Milbank. Williams and Wilkins Company, 1932, pp. 370 *et seq.*

<sup>10</sup> F. H. Top and H. F. Vaughan, Special Report of the Detroit Dept. of Health on Epidemiology of Poliomyelitis in Detroit in 1939.

<sup>1</sup> Aided, in part, by the Rockefeller Fluid Research Fund of the Stanford University School of Medicine.

<sup>2</sup> L. G. Dobson, E. F. Holman and W. C. Cutting, *Jour. Am. Med. Assoc.*, 116: 272, 1941.

<sup>3</sup> We wish to thank the Baltimore Biological Laboratory for supplies of thioglycollate medium, and the Lederle Laboratories for sulfadiazine.

sulfadiazine were similar to those with sulfathiazole (9 cultures).

The S strain was grown on thioglycollate medium for 20 days, at which time there was luxuriant growth in every tube. Autoclaved thioglycollate medium containing sulfanilamide, sulfathiazole or sulfadiazine was then added to the cultures in amounts to make the total drug concentration 50 or 100 mg per cent. (5 results with each drug in each concentration). Fifteen days later the tubes were subcultured. While the controls grew profusely, only 3 cultures from the sulfonamide groups showed any growth at all, and this was minimal. There was no growth in the subcultures of the sulfathiazole or the sulfadiazine tubes.

The M strain, when grown aerobically, gave a plentiful growth in one month. A similar amount of growth, although somewhat slower in development, occurred in cultures containing 10 mg per cent. of sulfanilamide (3 cultures). No growth occurred in cultures containing 50 or 100 mg per cent. sulfanilamide, or 10, 50 or 100 mg per cent. of sulfathiazole or sulfadiazine (3 results with each drug in each concentration).

Thus it is apparent that any of the 3 sulfonamide drugs used more or less completely inhibited the aerobic growth of both strains of actinomyces. Low concentrations were less effective than high, and sulfanilamide was less effective than sulfathiazole or sulfadiazine.

#### ANAEROBIC CONDITIONS

The S strain was grown anaerobically on Krainsky's medium in sulfanilamide, sulfathiazole and sulfadiazine, at 10, 50 and 100 mg per cent. concentrations (3 results with each drug in each concentration). Growth was plentiful in the control tubes, and in one of the sulfanilamide (10 mg per cent.) tubes in one month. Of the remaining 26 tubes, 8 showed very slight

growth, while 18 showed no growth. The positive growths occurred irregularly in the presence of the various drugs in different concentrations.

The S strain was grown anaerobically on thioglycollate medium with sulfanilamide, sulfathiazole and sulfadiazine in concentrations of 10, 50 and 100 mg per cent. (3 results with each drug in each concentration). In comparison with the vigorous growth in the control tubes in one month, sulfanilamide permitted equally good growth in 10 and 50 mg per cent. concentrations, and poor or no growth in 100 mg per cent. concentrations. Sulfathiazole allowed fair growth in 10 mg per cent. concentrations, poor or none in 50 and 100 mg per cent. concentrations. Sulfadiazine allowed little or no growth at any concentration.

The M strain was grown anaerobically with sulfanilamide, sulfathiazole and sulfadiazine in concentrations of 10, 50 and 100 mg per cent. (3 results with each drug in each concentration). Growth in the control tubes was moderate, and that in sulfanilamide (10 mg per cent. concentrations) was almost as good, but it was absent in all other tubes after one month.

The anaerobic results, therefore, agreed with the aerobic.

#### CONCLUSIONS

- (1) Aerobic and anaerobic cultures of two strains of *Actinomyces hominis* were inhibited to some extent by sulfanilamide in a concentration of 10 mg per cent.
- (2) Concentrations of 50 and 100 mg per cent. checked growth more or less completely.
- (3) Sulfathiazole and sulfadiazine were definitely more effective than sulfanilamide in similar concentrations.

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## SCIENTIFIC APPARATUS AND LABORATORY METHODS

### AN APPARATUS FOR ROLLER TUBE TISSUE CULTURE

THE roller tube method of tissue culture, originated by Gey<sup>1</sup> and developed by Lewis,<sup>2</sup> is being more and more widely adopted. The apparatus usually employed, consisting of a 1/20 h.p. electric motor, reduction gears and a rotating tube carrier, has several disadvantages. It is expensive and causes more or less noise and vibration. The motor can not be housed inside the incubator because it develops sufficient heat of itself to exceed 38° C. This necessitates a cum-

bersome apparatus with a shaft running from the motor through the wall of the incubator to the tube carrier.

A relatively simple and inexpensive device which does not have these disadvantages has been successfully used in this laboratory. The apparatus consists of a motor and tube carrier conveniently mounted to form one complete unit.

The general structure of this apparatus is shown in Fig. 1. The motor, A, was obtained from a General Electric clock, of the dressing table type, having an automatic starting mechanism. The motor was detached from the clock and removed from its metal housing. The exposed gears were removed until there

<sup>1</sup> G. O. Gey, *Am. Jour. Cancer*, Vol. 17, 1933.

<sup>2</sup> Warren H. Lewis, *Contributions to Embryology* No. 150, July, 1935.

remained only the gear on the main drive shaft and two gears connected to it. One of these was found to turn at a speed of 9 revolutions per hour, a satisfactory rate for rotating the cultures. A piece of 1/32 inch sheet brass, B, cut so as to leave the desired gear well exposed, was fastened to the face-posts of

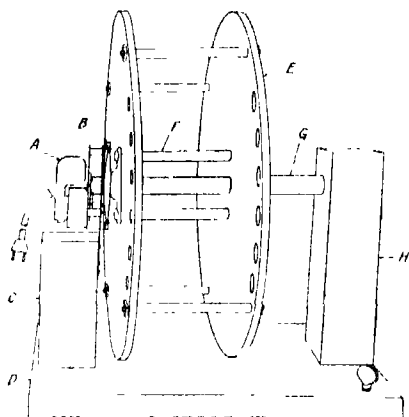


FIG. 1

the clock, and a small hole drilled through this sheet supported the end of the shaft of the intermediate gear. The sheet of metal also served to fasten the motor to its mount, C, a 4 5/16 x 2 x 2 inches wooden post fastened with screws to the 12 x 9 x 3/4 inches plywood base, D.

The roller tube carrier, E, consists of two circular pieces of 1/4 inch plywood, 12 inches in diameter, with eighty-four 5/8 inch holes to accommodate the test-tubes. These wooden discs were mounted on the frame of a bicycle pedal, F, and further secured to each other by 4 metal rods at their peripheries. The

distance between the discs so mounted is 3 1/2 inches. The posterior disc was fitted with a cardboard backing with holes 1/2 inch in diameter to prevent the tubes from sliding out of the carrier. The bicycle pedal should be of good construction, about 4 1/2 inches long, with ball bearings. The shaft of the pedal was screwed into a steel bar, G, 4 3/8 inches long, fitted snugly into a hole drilled through a wooden post, H, 7 1/2 x 2 x 2 inches. This post was screwed to the base.

The motor was attached to the tube carrier, as shown in Fig. 2.

A thin strip of metal, A, 3 inches long and 1/4 inch wide, was soldered to the end of the bicycle pedal, B. A similar strip of metal, C, was soldered to a metal table, D, which was in turn soldered to the face of the clock gear, E. These two metal strips, A and C, were given a ten-

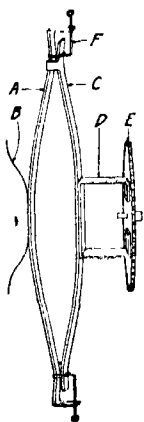


FIG. 2

dency to spring apart at the ends, and were clipped together by a sliding wire loop, F, at either end. This connection is sufficiently flexible to center itself as the gear turns and makes unnecessary a precise alignment of the clock gear with the shaft of the pedal. The connection is easily demountable.

The base of the unit is furnished with two thumb-screws at the anterior end for adjusting the tilt of the apparatus necessary to keep the tubes in place and to prevent fluid from wetting the stoppers in the tubes.

This apparatus can be housed in any incubator having adequate interior dimensions and an A.C. electric outlet inside the oven. In our laboratory we use it in a home-made plywood oven which is insulated with rock-wool and heated by thermostatically controlled electric light bulbs. The inside dimensions of this oven are 19 x 15 x 12 inches, and the walls are 3 inches thick. An inexpensive electric temperature control, manufactured by the Lyon Electric Company, San Diego, California, called the Lyon T 23 Breaker, is used. An A.C. outlet is installed in the back wall of the oven into which the roller tube apparatus is plugged.

This unit is silent in operation and produces no vibration. The synchronous motor assures a constant speed. The single unit construction allows the apparatus to be easily transported; it can be used in or out of the incubator as desired and can be changed from one place to another in a few seconds. The total cost of materials used in constructing the apparatus, including the motor, should not exceed seven dollars.

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## SCIENCE AND NATIONAL DEFENSE<sup>1</sup>

By Dr. **VANNEVAR BUSH**

PRESIDENT OF THE CARNEGIE INSTITUTION OF WASHINGTON; DIRECTOR OF THE OFFICE OF SCIENTIFIC RESEARCH AND DEVELOPMENT, WASHINGTON, D. C.

In this discussion of the present position of science and research in National Defense I will confine myself to two points. The first concerns the form of organization under which the scientists of this country are working. The second, which is very brief, has to do with the spirit with which the task is undertaken. As to the work itself I can not, of course, be specific at the present time.

Details of the organization have been made known, but I think they are not well understood generally. In June, 1940, there was formed, by order of the

<sup>1</sup> From an address delivered at the joint luncheon of the Acoustical Society of America, the Optical Society of America and the Society of Rheology in New York on October 24, 1941.

Council of National Defense, a group called the National Defense Research Committee (NDRC), for the purpose of supplementing the work of the Army and Navy in the development of devices and instrumentalities of war. This new organization was intended to function in an executive, not an advisory, capacity. The advisory function was being adequately cared for by the National Academy of Sciences, which has been in existence since the Civil War period, having been created by Act of Congress for the express purpose of advising the government on its scientific and technical problems. There was, however, need for a civilian group with executive powers to supplement the scientific and technical work of the Army and Navy, for,

in the emergency, an expansion of the scientific attack on war problems was essential, and the Army and Navy could not themselves undertake this immediately and fully. This need resulted in the formation of the NDRC as a means for enrolling a large number of civilian scientists to assist in research on problems of national defense as promptly as it could be done. The NDRC was formed as an operating part of the emergency governmental machinery, in contrast with the position of the National Academy of Sciences, which is an independent organization, operating under a congressional charter which defines its obligation to render advice when called upon by government agencies. The NDRC thus is intended as an emergency organization and is not of permanent character as is the Academy.

Let me say in passing that, in order that the Academy and the Research Council may most effectively carry on their exceedingly important work, it is very essential that they maintain their independent status, for this gives added force to their opinions on scientific problems as expressed to agencies of government.

NDRC consists of six civilians (including the President of the National Academy of Sciences and the Commissioner of Patents), an officer of the Army, and an officer of the Navy. Initially it was organized in four divisions: one under R. C. Tolman, of the California Institute of Technology; one under K. T. Compton, president of the Massachusetts Institute of Technology; one under F. B. Jewett, president of the National Academy of Sciences; and one under J. B. Conant, president of Harvard University. There are now about 60 sections in these divisions, composed of voluntary part-time and full-time workers, plus a few technical aides who are paid by the government.

The committee operates primarily by means of contracts with universities, colleges, research institutes and industrial laboratories. These contracts are initiated and supervised by the various sections and there are now about 450 of them in operation with nearly 120 contractors. These contracts are drawn with the intent that the contractor, whether university or industrial laboratory, shall neither gain nor lose financially through participation in these defense research activities. Such an aim is difficult to achieve, of course, but we are now making a careful study of the situation to see how close we have come to this goal.

The NDRC has tried to carry out its work with a minimum of interruption to the regular affairs of the universities. Of course it is not possible to proceed without disruption and inconvenience, but that has been held down as far as possible. Many a physics department throughout this country has nevertheless been put to very great stress. The men who have carried on under a heavy overload, continuing the

work of the university in order that some of their colleagues might participate directly in the defense program, are contributing no less to the national interest than are those immediately engaged in the sections of NDRC or otherwise.

The number of people involved in the work of the committee is rapidly increasing. There are now about 500 individuals in the NDRC organization who serve as members of sections, consultants, and so on. About 2,000 scientific men are engaged in defense research in connection with NDRC contracts, and probably there is an equal number of helpers.

The NDRC spent about ten million dollars during its first year, and it had nearly as much for the second year, beginning July 1, 1941. If the President signs the bill which was passed by the Senate yesterday, another large sum will become available. I feel quite sure that if a bottleneck should develop, it would not be caused by the number of problems that are important and should be worked on, nor by lack of funds with which to carry on the work, but by a shortage of available personnel. For example, a recent study indicated that, of the available physicists whose names are starred in "American Men of Science," about 75 per cent. are now engaged in war research in one way or another. I think the other 25 per cent. who are still available will soon be called upon. The call for chemists has not been so great as it was in the last war—about 50 per cent. is the corresponding figure. In addition, many engineers are thus engaged, but in their case it is not easy to arrive at a comparable figure.

Effort has been made to spread the work, but that has not been possible in some instances. For some problems it has been necessary to gather an outstanding group in one place in order to provide the advantages of a concentrated attack. Such concentration has occurred under several universities in this country, men having been brought from other institutions for that purpose. Within this next year, however, we hope to spread the work much more than was practicable in the great haste of initiating activities in the summer of 1940.

The special function of NDRC, as previously stated, is to supplement the work of the Army and Navy in the development of devices and instrumentalities of war. Let me say immediately that, in spite of difficulties due to lack of funds in the years preceding this emergency, the Army and Navy, in my opinion, have done a very fine piece of work in research, in development and in proceeding toward advanced instruments of war. We are supplementing previous work, not starting anew, in almost every field in which we operate.

There is very close liaison with the Army and Navy, each section of NDRC having its own liaison officers.

These officers represent some of the brightest, keenest men in the armed services on the technical front. Relations have been cordial, and I believe that many a scientist has gained, through his work with the Army and Navy, a new respect for the burden being carried and for the quality of the men who are carrying it. I think, too, that many an officer in the Army and in the Navy has gotten a somewhat different idea, in the course of the past year, of the scientists of the country. They have found that the scientist is not necessarily a person with "long hair," but that he can attack a problem in a practical way, and that he can work long hours and take it with the best. As a result, there has developed a mutual respect which is very heartening.

There has been interchange of scientific and technical information with Britain on an excellent basis. Dr. Conant went to England and established a London office of NDRC, and this is now in charge of Mr. Hovde. Likewise, the British have a Central Scientific Office in Washington. There is complete and free interchange with the British on every aspect of the scientific attack, and this is proving of mutual advantage.

Having thus given you the salient points in regard to NDRC, I will now tell you of a new organization. Last June, after just one year of operation by the NDRC, the President, by Executive Order, established the Office of Scientific Research and Development (OSRD), of which I am director, to coordinate all defense research wherever it might occur. The OSRD has two major divisions, one being the National Defense Research Committee, which continues as before, except that Dr. Conant succeeded me as chairman and Dr. Roger Adams has taken over Dr. Conant's previous duties. In addition, there is a business office under Dr. Stewart and a liaison office under Mr. Wilson, the latter being principally engaged in handling our relations with the British.

The second major division of OSRD is the newly-formed Committee on Medical Research, of which Dr. Richards, of Pennsylvania, is chairman. This committee is constituted in much the same way as the NDRC, and it shares with NDRC the funds furnished OSRD, in order to conduct medical defense research. It works primarily with the Division of Medical Sciences of the National Research Council, which had already been active in this field and had organized committees necessary to carry on such work, of which there are about 50. The Committee on Medical Research has close relations with the U. S. Public Health Service, as well as with the Surgeons General of the Army and Navy, having in its membership a representative from each of the three offices.

The OSRD has an Advisory Council which includes the chairman of the two main groups, Dr. Conant and Dr. Richards, and the chairman of the National Advisory Committee for Aeronautics, which for twenty-five years has been bearing the principal burden of aeronautical research in this country for the Army and Navy. That the NACA is a very active organization is shown by the fact that its budget for the present fiscal year is about six million dollars for operation, plus about twenty-four million available for new construction. Also on the Advisory Council is a Special Assistant to the Secretary of War, who is charged with keeping the Secretary apprised of the status of research and development throughout the War Department. He has also the duty of maintaining relations with organizations outside the department, on matters of research and development, through his connection with OSRD. The Navy is represented on the Council by the Coordinator of Research of the Navy, who has similar duties in the Navy Department to those just described for the War Department representative on the council.

We have, therefore, in the OSRD Council a definite way of bringing together the groups that are concerned. The new office is charged with the duty of mobilizing the scientific effort of the country by providing a focus at which all defense research is considered; supplementing the work of the Army and Navy, directly through its own organizations, by research on instrumentalities and materials of war on the one hand, and by medical research on the other; advising the President as to the status in this country of scientific research and development in their relation to defense; initiating, in cooperation with the Army and Navy, broad programs of research where needed; carrying on such research as may be requested by those countries whose defense is considered by the President to be essential to the defense of the United States. With our close relation to Britain, I am quite sure that the requests will be many. For example, Britain has been forced to drop much important medical research. British physicians are too busy with immediately urgent matters, and we must pick up that burden.

The OSRD is aided by many organizations that are not directly concerned in the activities of its two main groups. I mention, for example, the National Roster of Scientific and Specialized Personnel under Dr. Carmichael, which, together with the National Research Council, is undertaking the very important task of locating competent personnel. There is also the National Inventors Council, formed under the Department of Commerce for the purpose of evaluating the very large number of suggestions coming from the

public. The Inventors Council has a difficult and somewhat thankless task, but is doing it very well indeed. The wheat they sift from the chaff is passed on to the Army and Navy for development as needs arise.

Thus there exists in the organization of the Office of Scientific Research and Development the basis for an effort commensurate with the importance of science in modern war, which is a very high order of importance indeed. Of the work itself I can not of course tell at this time, but it will be a striking story when it is finally revealed. With 60 active sections in the NDRC and 50 committees in the CMR, the range of work is obviously large. I can, however, mention one thing that has already been made public. When the Battle of Britain took place in August, September and October, 1940, invasion failed for two reasons: First, the British fighting forces in the air were courageous, skillful and well equipped, better equipped than were the invaders in many ways; secondly, radio detection, developed by a group of devoted British scientists working from 1935 on, at times without much encouragement, offset the element of surprise. This one development may have saved the isle of Britain. It is one field of obvious importance; others undoubtedly occur to you.

Most of the matters that OSRD handles are quite naturally clothed with the mantle of secrecy, for every precaution must be taken in dealing with military matters of great potential importance. The various sections are working in specific fields, and the affairs of the organization have been compartmentalized in order better to follow the general policy of permitting a man to learn confidential things only to the extent that is necessary in order that he may function effectively. Another rule is that, in working with people outside the organization, OSRD members listen and do not talk. It is not the most agreeable way of working; it is not natural for a scientist, but it is necessary under present circumstances. Appointments to posts in the organization are made only when the Army and Navy, after careful investigation, have in-

dicated that they have no reason to suspect that there is not complete loyalty.

I said that there were two points to be considered. One is the organization, but organization is very little. The spirit in which the work is conducted is much more important. There is no unanimity in this country as to how or when or where or to what extent the power of this nation should be exerted to defend our way of life. But there is unanimity on the thesis that the power of this country must be increased at once and to the maximum possible extent.

The scientists of this country have done more than speak on this subject. They have taken off their coats and gone to work, and much academic research has been postponed in the process. The matter of credit has been utterly forgotten. They have shown a willingness to work under necessarily rigid restrictions, as well as with a reasonable tolerance of the petty inconveniences and annoyances that are inevitable in the confusion of adapting themselves to military ways. They have shown that they are willing to go into a strange ball park and learn the local ground rules. In only a year they have done things. Ordinarily, it is at least three years from an idea in the laboratory to its use, and yet I say to you that results are being obtained, and they are taking form in copper and iron. Those of you who are privileged to participate in this work, as I am, will find therein a deep satisfaction, even though it substitutes for a thing we held more highly: the privilege of contributing to the growing knowledge of the race. Those of you who are not participating directly, but are holding the fort in order that your colleagues may participate, or who are carrying on in a field where the thread of growing knowledge might otherwise be broken in the present distress of the world, will also look back some day to this period, not only as a time of stress, but as a time when we were all privileged to participate in one thing on which we could become united: the defense of the country to which we owe our allegiance. The scientists of this country are united, and they are obtaining results.

## ATMOSPHERIC-ELECTRIC DISTURBANCES ACCOMPANYING THE BRIGHT AURORAS OF MARCH 25, 1940, AND SEPTEMBER 18, 1941

By Dr. HARLAN T. STETSON

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IN an article on "The Present State of Solar Activity and Associated Phenomena" printed in *SCIENCE* two years ago,<sup>1</sup> the results of an investigation of the

<sup>1</sup> Harlan T. Stetson, *SCIENCE*, 90: 2343, 482-484, November 24, 1939.

brighter aurorae observed at the Blue Hill Observatory during the last 35 years indicated a lag of about one year between the occurrence of a sunspot maximum and the period of the greatest auroral activity.

As was therein indicated, the sunspot maximum passed with the passing of the years 1937-1938.

Two unusual auroral displays worth special mention have occurred during the last two years—the Easter disturbance of March 24-25, 1940, and the great aurora of September 18-19, 1941. Both of these auroral dates were preceded by a week of marked sunspot activity. The dates of the most conspicuous display of the polar lights in the two instances followed about one day after the passage of the respective sunspot groups across the sun's meridian. This again confirmed not only the association of such displays with particular sunspot areas, but reaffirmed the reality of the lag between the central position of the sunspot group on the sun and the occurrence of the aurora with its accompanying disturbances to the earth's magnetic field and to radio communication.

The importance of radio technique as a tool in investigating the atmospheric-electric disturbances accompanying auroral phenomena was stated in the article mentioned, but is specifically well illustrated in the behavior of radio field strengths as measured at this laboratory for the week preceding and following each of these remarkable displays of the polar lights.

In Fig. 1 is depicted the field strengths in microvolts

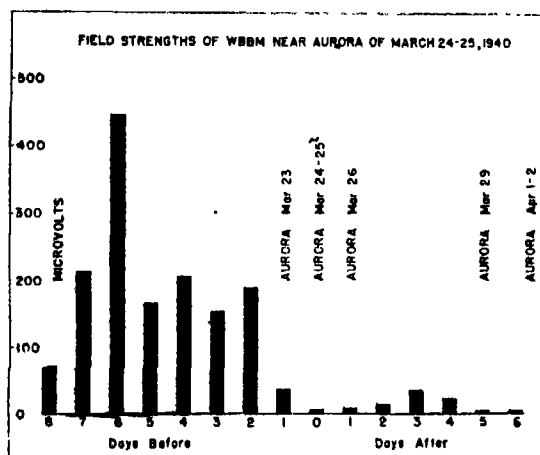


FIG. 1

per meter of the carrier wave of the broadcast station WBBM Chicago as received in the vicinity of Boston from March 17 to April 2, 1940. Since the 800-mile distance between Chicago and Boston is far beyond the radius of the ground wave, the variations in field intensity measurements are introduced through changes in the electrical characteristics of the ionosphere. Furthermore, the moderately long radio waves of WBBM's frequency (770, 780 kc.) presupposes reflection from the lower or E region of the ionosphere. The observations are based solely on night field strengths, since on account of the highly ionized state of this region in sunlight, the day field is rendered

unmeasurable at the distance cited. The normal field strength based on many thousand hours of observations over a period of ten years is of the order of 100 microvolts per meter at the observing end. Reference to the diagram will show that the week preceding the auroral date of March 24-25 was a week of abnormally high reception and that the week following the auroral occurrence was marked by abnormally low fields.

A statistical study of the behavior of field strength measurements around auroral dates based on ten years' observations has been published elsewhere<sup>2</sup> and is graphically summarized here in a block diagram (Fig. 2). The top part of the diagram represents the mea-

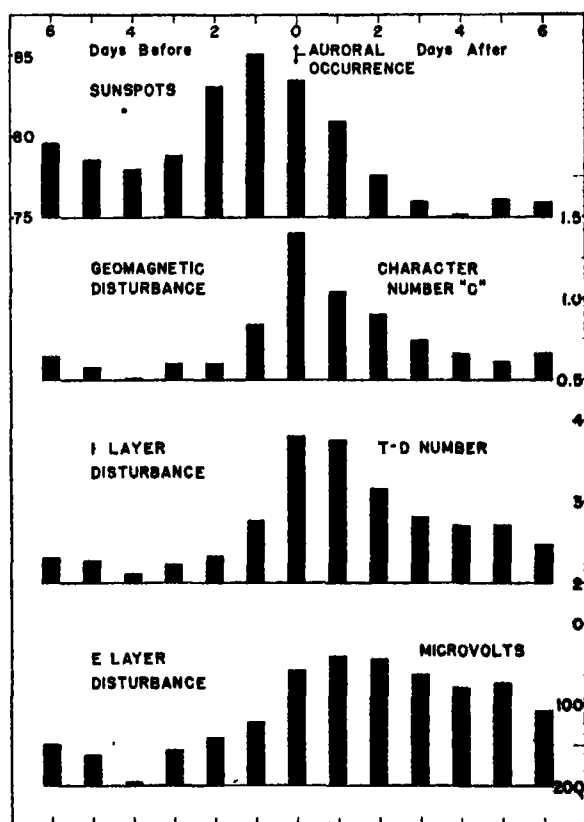


FIG. 2

sure of solar activity in terms of the conventional Zurich sunspot numbers. It will be observed that on the average the peak of solar activity precedes the date of auroral occurrences by one day.

At the bottom of Fig. 2 there is plotted the disturbances to the E layer based on field intensities. The height of each column plotted represents the inverted field intensities so that the weakest intensities correspond to the days of greatest disturbance to the E layer reflections. It will be seen that for the week

<sup>2</sup> *Idem, Jour. of Terrestrial Magnetism and Atmospheric Electricity*, 45: 1, 80, March, 1940.

preceding the auroral occurrence, disturbances were remarkably low, the very lowest value occurring four days preceding when remarkably high field intensities of 200 microvolts were recorded. Following the auroral dates was a week of unusual disturbance with corresponding low values of field intensities, ranging from but 50 to a little over 100 microvolts per meter. This suggests that the damage suffered by the E layer requires nearly a full week for recovery. The lag between the maximum disturbances in this broadcast band and the date of the auroral occurrence of about one and one-half days appears definitely real.

Field strength measurements at the higher frequencies involving the F region during this period were not immediately available, but through the courtesy of the Bell Telephone Laboratories, transmission disturbance figures served as a convenient index for comparison. These transmission disturbance numbers for the wave-lengths used involve the F layer, and again show close correspondence with the values derived from field intensity measurements in the broadcast band except that the time of maximum disturbance is definitely nearer the date of the auroral occurrence. For comparative purposes the disturbances in geomagnetism based on the magnetic character number *C* are plotted for the same interval. The almost identical performance of the geomagnetic disturbance with that of the disturbances involving the F layer shows that the ionic changes affecting the earth's magnetism appear to be definitely associated with the higher ionized regions of the atmosphere in which the aurora itself occurs.

During the last year, in addition to the continuation of the field strength determinations at the broadcast frequency from WBBM, apparatus has been provided at this laboratory for measuring field strengths of the short waves continuously broadcast from the Bureau of Standards station (WWV) on 5 megacycles. The simultaneous records, therefore, obtained on both the moderately long and the short radio waves for days immediately preceding and following the great auroral display of September 18-19 are of immediate interest. In Fig. 3 are the records of these two series. In the upper part of the diagram are plotted the field intensities in microvolts of WWV. It will be observed that abnormally high reception anticipated the auroral date by several days, and that for the four days immediately following the auroral occurrence, field strengths were abnormally low, but strong recovery was shown by the end of the week. In the case of the field strengths of WBBM (780 kc.) involving E layer reflections, an abnormally strong field six days before the aurora showed marked weakening thereafter, with practically a zero record on the night of the aurora. Small recovery but with abnormally low field strengths

persisted throughout the entire week following. These measurements suggest that recovery from the E region is much more slowly accomplished than the recovery where the F layer is chiefly involved. If one were to smooth these curves by moving averages, the tendency for a lag between the period of maximum disturbance in the E and the F layer would be distinctly evident, confirming the deductions of the ten-year study shown in Fig. 2.

The sunspot group of September 18-19 represented a much greater disturbed area than the corresponding group preceding the aurora of March 24-25. Radio communication difficulties were experienced in both

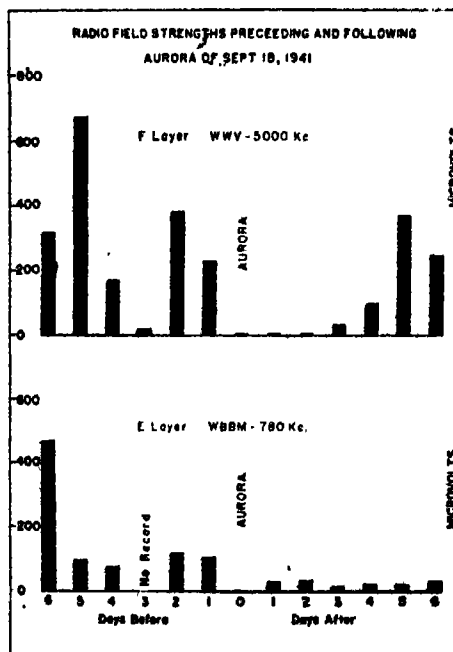


FIG. 3

instances. The communication complications of Easter Week, 1940, however, were of greater duration, but from Fig. 1 it will be seen that the major auroral display was followed by at least two other auroral occurrences in the days immediately following the major display. As has been previously pointed out in the article cited,<sup>3</sup> the lag of about one day between auroral occurrences and solar activity near the central meridian is consistent with the hypothesis of relatively slow moving particles passing from the disturbed regions of the sun to the earth's atmosphere. If such particles carry charges of one predominant sign, it is hardly to be expected that the trajectories of the flight of such particles will remain radial with respect to the sun. It seems possible that the trajectories of these ionizing particles will be warped not only by the earth's field in entering the atmosphere, as has been demonstrated by Störmer, but that the initial

direction taken in the immediate vicinity of the sun will be determined by the magnetic field of the sun together with that of the sunspots in the disturbed area from which the particles emanated. It is suggested that this may be at least one reason why in many instances large sunspots may cross the central meridian without accompanying auroral displays, and on the other hand, the biggest auroral disturbances may occur long after the passage of even a conspicuous sunspot as was the case in the instance of the aurora on January 25, 1938.

It is of interest that for the days near the date of the aurora of September 18, no significant changes in the potential gradient of the atmosphere at the earth's surface level were noted in the examination of the records obtained from our potential gradient recorder. The point discharger in operation at this laboratory which records significant passages of atmospheric-electric currents between the sky and the earth recorded no discharges surpassing those of the usual fair-weather intensity. These observational records of the lower atmosphere, therefore, give no indication of atmospheric-electric phenomena below the region of the ionosphere accompanying the auroral displays of September 18.

It has sometimes been stated<sup>3</sup> that the Northern Lights are seldom seen south of the Canadian border. It may be of interest in the amplification of this statement to note that in the list of aurorae observed at the Blue Hill Observatory, over 400 have been recorded since 1887. Returns from observatories of the Easter aurora of March 24-25, 1940, demonstrated that the aurora was seen in that instance as far south as Texas and Arizona and that the line of visibility in the South Atlantic states was cut by cloudiness. The aurora of September 18-19, 1941, was conspicuous over practically the entire area of the United States.<sup>4</sup> An authenticated observation of one of my associates gives assurance for an auroral display having been visible in Mexico City several years ago. Other instances are of course on record.

Dr. C. F. Brooks, director of the Blue Hill Observatory, has kindly sent to me in manuscript form a somewhat detailed discussion of his observations of the aurora of September 18, which is reproduced herewith with his permission.

<sup>3</sup> *Scientific News Letter*, 40: 12, 187-188, September 20, 1941.

<sup>4</sup> Since this was written a communication from Chief Reichelderfer of the U. S. Weather Bureau reveals that this aurora was reported by 106 of its subsidiary stations covering 47 of the 48 states; Arizona alone not officially reporting the display. In several instances the aurora was reported as visible on September 17, 18, 19, 20 and at Saint Saint Marie extending even to September 21.

OCCASIONAL OBSERVATIONS OF THE GREAT DISPLAY OF  
AURORA BOREALIS OF SEPT. 18, 1941, AT MILTON,  
MASSACHUSETTS

EST

- 7: 20 p. General illumination over prac. entire sky, down to about 15° above S. hor. Corona moderately developed.
- 7: 38 p. Bright arch with beams about 30° S. of zenith. Corona.
- 7: 50 p. (approx.) Crimson spot in W. Fairly bright arch up abt. 25° in S.
- 7: 54 p. Gorgeous red and green corona in rapid motion, to with waving red and green curtain over much of southern sky. First (1) flickers (rapidly upward) from bright spots in NW and S.
- 8: 14 p. Generally colorless, not much light, though extensive; no flickering.
- 8: 16 p. Corona and flickering.
- 8: 29 p. General curtain in south, reaching to zenith. General corona; lights in all directions. 1 color.
- 9: 30 p. General illumination; pulsating; no color. Arch with streamers in NW about 25° up. (Arch prob. more extensive; view of NE sky mostly cut off.)
- 10: 05 p. Corona narrowly developed in band from overhead to about 20° south of zenith. Little if any lights in northern sky. Not pulsating, but movements rapid (of the lateral or unvolving type).
- 10: 35 p. Brightening up. "Searchlight" in NW. Corona. Broad arches at about 20° up in north; 70° up in N to 80° up in S.; and 20° up in S. No pulsating.
- 10: 55 to 11: 00 p. A maximum phase nearly as great as that just before 8 p. Rapidly moving colored corona, taking on nearly circular form about 15° in radius.
- 11: 15 p. and later, the aurora continued, with much general illumination, punctuated by beams. CFB did not observe after about 11: 30 p., but Miss Margaret Sutermeister, nearby, saw it about every hour during the night, though she did not notice any illumination at 4 A.M., up to which time radio reports said the display was still visible.

(Note: On Tuesday morning Mr. H. H. Clayton's projection of sunspots showed a very considerable group beginning to cross the center of the sun's disk. This led me to write Mrs. Brooks to "Look out for an aurora tomorrow night." The display began, as predicted, Wed. evening, and on Thursday morning, Mr. Clayton reported by card: "Very brilliant aurora seen here (Canton, Mass.) 3 A.M. to 3: 45 A.M., continuing: brightness 3 on scale of 0 to 3; double arches, one about 20°, the other 40° to 50° high with streamers to zenith; shades of green and red seen in brightest portion." The aurora evidently continued throughout the day, and was very brilliant (as described above in detail) Thurs. night. Continuing through

Fri. it was seen again Fri. evening, the 19th, though very low in the north.)

CHARLES F. BROOKS

The occurrence of the Northern Lights is of course unquestionably the most spectacular evidence of the high degree of ionization of the upper atmosphere that may be produced from radiation disturbances apparently originating in the sun itself. The use of radio technique affords a new tool for accumulating data that may ultimately help in the solution of the

mechanism involved in the ionization of the upper air due to such solar conditions as are conducive to the incandescent visible discharges producing displays of the Aurora Borealis.

The phenomenally high field intensities that appear to predominate the week previous to the occurrences of aurorae with their accompanying ionospheric disturbances suggests that field intensities may be used along with sunspot activity to predict periods of poor communication.

## OBITUARY

### WALTER MATHEW DUNAGAN

MAY 23, 1894—NOVEMBER 24, 1941

WALTER M. DUNAGAN, associate professor of theoretical and applied mechanics at Iowa State College, died on Monday, November 24, as a result of an emergency operation for a stomach ailment.

Professor Dunagan was born in Des Moines 47 years ago, was a graduate of East Des Moines High School, had an A.B. degree from Simpson College, 1919, a B.S. in civil engineering from Iowa State College, 1923, followed by degrees of civil engineer, 1928, and master of science, 1930. His freshman year was spent at Grinnell College. In both high school and college he participated in football and in distance running. He was captain of the track team at Simpson and helped in football coaching for a number of years at Iowa State. His interest in athletics and hunting continued and he was one of the well-known amateur golfers of the state. He was a former member of the athletic council of the college and assisted locally at most of the major athletic events, including the Drake Relays. At the outbreak of the First World War he enlisted in the 109th Engineer Regiment of the 34th Division and held the rank of first lieutenant in the infantry at the time of his discharge in 1919.

After preliminary field experience with the South Dakota and Iowa State Highway Departments, Mr. Dunagan joined the civil engineering staff of Iowa State College in 1924 and in 1933 became associate professor of theoretical and applied mechanics. He had long been interested in construction and engineering materials, his best known technical contributions being the result of his researches and writings in the field of concrete. In this field his name was internationally known and he was drawn in as a consultant on a great variety of concrete problems many of which were in connection with novel or large construction. He was also the friend and counselor of the small concrete practitioner and for years there have been few concrete jobs in central Iowa upon which he was not consulted formally or informally.

He spent occasional periods as a member of the research and testing staff of the Portland Cement Association at Chicago.

Professor Dunagan was the inventor of equipment widely used in the analysis of fresh concrete; the author of two important bulletins of the Iowa Engineering Experiment Station, one on "The Field Control of Concrete" and the other on "The Use of Color in Concrete"; of a manual for use in the teaching of courses in plain concrete and of several technical papers and discussions published in the proceedings of the American Concrete Institute and the American Society for Testing Materials. About five years ago he developed a type of reinforced tile floor construction which already has gained wide acceptance and use. One of his most interesting and successful researches was his own residence of monolithic concrete, completed only a year ago, in which he embodied many unique features of both a utilitarian and artistic nature.

His membership in professional and technical organizations included: The American Society for Testing Materials, in which he had long been active, being chairman of Subcommittee VIII of C9, on Permeability Tests of Concrete; American Concrete Institute, some of his most recent labors having been in connection with the work of Committee 613, on the Design of Concrete Mixtures, besides being chairman of Committee 408 on Color in Concrete, and the Iowa Engineering Society, of which he was for a number of years chairman of the Committee on State Building Code. He was also a member of the Society for the Promotion of Engineering Education and was a registered engineer in the state of Iowa. He belonged to Epsilon Sigma and Sigma Xi, scholastic and scientific honorary societies, to the Knights of St. Patrick and to the Alpha Tau Omega social fraternity. He was a member of the American Legion and the Masonic Lodge and had served as superintendent of the Methodist Sunday School and as a member of its orchestra.

As a teacher he was inspiring and exerted a pro-

nounced motivational influence upon his students. His mental processes were original and through his encouragement and stimulating suggestions, he started or contributed to a great variety of enterprises with many of which his name was never formally associated. Typical of these was the College Recreational Area, which contains one of the unique golf courses of the country. The original concept was his and he had had his students in surveying working on that hypothetical project years before there was a thought of its possible fulfillment.

Professor Dunagan lived an intense life filled with many interests. Into each experience he breathed significance; chores became adventures. Few indeed

were the situations in which he failed to discover both color and humor. He was a lover of people and beloved by them; to know him was to be his friend. His passing came at the height of his productive effort; on the morning of his death he said "I am going; there are so many things I want to do." That was characteristic of the man.

His home life was a happy one; he is survived by his wife, Dorothea Porterfield Dunagan, and two daughters, Dorothea M., a sophomore in college, and Sheila P., a junior in high school, and by three brothers and a sister.

HERBERT J. GILKEY

IOWA STATE COLLEGE

## SCIENTIFIC EVENTS

### CHILD ENDOWMENT IN AUSTRALIA

ACCORDING to *The Lancet*, by an act which came into force early this year a federal system of child endowment has been introduced in Australia. From July 1 a payment of 5s. per week will be made for each child under sixteen years of age in families containing more than one child, and a similar allowance will be made to children in approved charitable institutions. Normally the endowment will be paid to the mother and must be used for the child's "maintenance, training and advancement." It is estimated that about a million of the 1,830,000 children in Australia under the age of sixteen belong to families with more than one dependent child so that the annual cost of the scheme is some £13,000,000. Two millions of this will be gained by abolishing income-tax abatements for each child after the first (so that the 5s. will not in some cases be a clear gain), two millions from general revenue and nine millions from the proceeds of a new pay-roll tax. An account of this legislation given in the *Ministry of Labour Gazette* for September, 1941, shows that the tax is payable by all employers with a pay-roll of over £20 a week and is at the rate of two and one half per cent. on all wages, salaries, commissions, bonuses or allowances paid in money or kind. A similar but localized movement to ease the position of families with young children is reported from Birmingham. Acting on the advice of its salaries, wages and labor committee the city council has decided to give married employees 2s. 6d. a week for every child of school age, an innovation held to be more appropriate to war-time conditions, and fairer, than a general advance in wages for married and unmarried alike. The alternative method now to be widely extended is to provide a good midday meal for all school children. This has the special advantage that it reaches not only necessitous children but also those whose mothers find it difficult, with or without

endowment, to combine work of national importance in factories or elsewhere with the task of running a household. Appliances, staff and suitable premises may be hard to come by, but such difficulties are not to stand in the way.

### THE FOURTH CONSTITUTIONAL CONVENTION OF THE CONGRESS OF INDUSTRIAL ORGANIZATIONS

AT the fourth constitutional convention of the Congress of Industrial Organizations held recently at Detroit, the following resolutions were adopted:

WHEREAS (1) The Federation of Architects, Engineers, Chemists and Technicians has organized a majority of the 800 industrial research workers at the Shell Development and Research Laboratories at Emeryville, Calif., one of the outstanding research institutions in the world; and

(2) The American Chemical Society, a national professional scientific association, whose officers are a cross section of the outstanding industrial corporations in the nation, such as Standard Oil and du Pont, has launched an anti-union campaign nationally, threatening a permanent blacklist against chemists and technicians who join the CIO, and cooperating with anti-union employers in a process of intimidation; now, therefore, be it

Resolved (1) That the Fourth National Convention of the Congress of Industrial Organizations goes on record as supporting the organization of the Shell Development and Research workers, the Federation of Architects, Engineers, Chemists and Technicians, in its efforts to insure the rights of collective bargaining to the technical workers, and

(2) That we advise the National Labor Relations Board of our support to the Federation of Architects, Engineers, Chemists and Technicians' petition for a single bargaining unit; and

(3) That we emphatically protest the anti-union, undemocratic interference of the American Chemical Society in the efforts of technical workers to achieve industrial democracy and collective bargaining rights, and denounce

the attempts of employers to pervert a scientific body into an anti-union instrument and weapon against the CIO.

### FELLOWSHIPS IN THE MEDICAL SCIENCES OF THE NATIONAL RESEARCH COUNCIL

FELLOWSHIPS in the Medical Sciences, similar to those which have been administered by the Medical Fellowship Board of the National Research Council since 1922, will again be available for the year beginning July 1, 1942. These fellowships, supported by grants from the Rockefeller Foundation to the National Research Council, are designed to provide opportunities for training and experience in research in all branches of medical science. They are open to citizens of the United States or Canada who possess an M.D. or a Ph.D. degree, and are intended for recent graduates who are not yet professionally established.

In addition to these fellowships the Medical Fellowship Board administers two groups of research fellowships, made available through a grant from The National Foundation for Infantile Paralysis, Inc. The first group, open to applicants who hold either the Ph.D. or M.D. degree, is for the purpose of providing opportunities for special training and experience in the study of filtrable viruses. The second group, open only to graduates in medicine who have completed one or more years of hospital experience in clinical surgery and are planning a career in orthopedic surgery, is designed to provide opportunities for training and research in those basic medical sciences which will be of particular value in furthering progress in the field of orthopedic surgery.

Fellows will be appointed at a meeting of the Medical Fellowship Board on February 28, 1942. Applications to receive consideration at this meeting must be filed on or before January 1. Appointments may begin on any date determined by the board.

For further particulars concerning these fellowships, address the Secretary of the Medical Fellowship Board, National Research Council, 2101 Constitution Avenue, Washington, D. C.

### UNITED STATES CIVIL SERVICE EXAMINATIONS

ACCORDING to a statement made by the U. S. Civil Service Commission, there still exists an acute shortage of explosives chemists, physicists and chemical engineers available for government work. Salaries in these positions range from \$2,600 to \$5,600 a year. For all of them appropriate college study and experience are required. The age limit has been raised to sixty years for regular probational appointment. Provision is also made for the waiver of age and physical requirements for temporary positions connected with the National Defense program.

A staff of investigators is maintained by the Material Division of the Air Corps to protect military information and air corps projects. These positions pay from \$3,200 to \$4,600 a year. To establish employment lists of investigators from which the War Department will make appointments, the Civil Service Commission has announced an examination. No written test will be given, but applicants will be rated on their education and experience.

A sufficient number of persons did not apply for the radio mechanic-technician positions announced by the Civil Service Commission on September 8. Accordingly, the announcement has been amended to make it "open continuous"—that is, applications will now be accepted until further notice; to add the position of chief radio mechanic-technician at \$2,600 a year; to modify the experience requirements, and to provide for the substitution of education for part of the experience.

The constant and increasing need for skilled industrial workers for National Defense is resulting in a diminishing labor supply. A partial answer to this problem is the apprenticeship program. In connection with this, the Apprenticeship Section of the Division of Labor Standards, Department of Labor, is planning to appoint about 200 field representatives who will be stationed throughout the country. The eligible register established as a result of an examination for field representative announced in October, 1940, is practically depleted; the commission therefore has found it necessary to announce another examination to fill these positions.

Full particulars in regard to the positions given above can be obtained by writing to the U. S. Civil Service Commission, Washington, D. C.

### AWARD OF THE CHARLES P. DALY GOLD MEDAL OF THE AMERICAN GEOGRAPHICAL SOCIETY

THE Charles P. Daly Medal for 1941 of the American Geographical Society was presented on November 21 to Dr. Julio Garzón Nieto, chief of the Office of Longitudes and Frontiers of the Colombian Ministry of Foreign Relations, in Bogotá. The ceremony took place at a banquet tendered by the Rotary Club of Bogotá and honored by the presence of the President of Colombia, the Minister of Foreign Relations and many personages prominent in social and scientific circles in Bogotá. The ceremonies were initiated by the reading of numerous congratulatory telegrams, and a medal of honor, especially created for the occasion, was presented to Dr. Garzón Nieto by Dr. Luis Lobo Guerrero.

Presentation of the medal was then made by the American Ambassador, the Honorable Spruille Braden. In his address Dr. Braden pointed out that for

more than thirty years Dr. Garzón Nieto has been director of the Colombian Office of Longitudes. During this period the principal work of his bureau has been the production of a series of maps of the departments of Colombia on the scale of 1: 500,000, based on astro-

nomical observations, made at hundreds of places throughout this country, and compiled to a considerable extent from surveys made expressly for them. This work was instituted by Dr. Garzón and has been carried on under his direction.

## SCIENTIFIC NOTES AND NEWS

ALFRED NOBEL, the Swedish industrialist, whose philanthropy is usually commemorated on December 10 in Stockholm or Oslo with the announcement of the new Nobel Prize winners, was honored instead at a dinner in the Hotel Roosevelt on December 11 at which eleven Nobel laureates were guests of honor. The celebration marked the fortieth anniversary of the first awards. The prizes have been suspended for the duration of the war. Nobel laureates who were present at the dinner included Viktor Franz Hess, Clinton Joseph Davisson, Enrico Fermi, Otto Meyerhof, Karl Landsteiner, Irving Langmuir, Harold Clayton Urey and Peter J. W. Debye. Dr. Vilhjalmur Stefansson presided.

THE Charles Reid Barnes life membership award to an outstanding plant physiologist of the American Society of Plant Physiologists will be presented this year at the annual dinner of the society. Philip R. White, recipient of last year's Stephen Hales Prize, will deliver the prize address on "Vegetable Dynamics and Plant Tissue Cultures." The society will meet with the American Association for the Advancement of Science at Dallas from December 29 to 31, inclusive. The program on Monday afternoon will be a symposium on "Electrodynamics of Living Systems." The annual dinner will be held on Monday evening. On Monday and Tuesday mornings and Wednesday morning and afternoon, sessions will be held for the presentation of submitted papers.

THE medal of honor of the American Group of the Société des Architectes Diplômés par le Gouvernement was presented at a dinner given in his honor at the Architectural League of New York City on December 12 to Dr. Frederick P. Keppel, who retired last month as president of the Carnegie Corporation of New York. The award was made in recognition of "distinguished service in the advancement of art and architecture."

THE Institute of Medicine of Chicago at its annual dinner on December 2 conferred the honor of citizen fellowship on Albert D. Lasker, advertising executive. Only ten such awards have been made in the history of the institute. Dr. Joseph A. Capps, in presenting Mr. Lasker, paid tribute to his distinguished ability in the business world and to his valuable contribution to medicine in realizing the "importance of research in

advancing understanding of the processes of disease and furthering the progress of medicine in its treatment." Mr. Lasker has given liberally to cancer research, to the investigation of the degenerative diseases and more recently to the cause of birth control.

DR. HERBERT GROVE DORSEY, chief of the Research Section of the U. S. Coast and Geodetic Survey, recently received the first annual award of the Washington Society of Engineers, "To a member whose accomplishments in engineering have made an outstanding contribution to the advancement of engineering knowledge and practice and to the maintenance of a high professional standard."

EDWARD KASS, M. Scherago and R. H. Weaver, all of the department of bacteriology of the University of Kentucky, have been awarded the King Prize of \$50 for the best paper presented at the 1941 meeting of the Kentucky Academy of Science. The award was in recognition of their work on "Enzymic Purification of Antitoxins."

DR. EDWARD H. HATTON, who recently retired as professor of pathology and bacteriology at the Dental School of Northwestern University, has received the Callahan Award of the Ohio State Dental Society for 1941. He will continue to serve as general secretary of the International Association for Dental Research, with an office at Northwestern University.

THOMAS J. TALBERT, chairman of the department of horticulture and forestry of the College of Agriculture of the University of Missouri, was reelected president of the American Pomological Society at a joint meeting of the society with the Michigan State Horticultural Society on December 4. The society is ninety-three years old and this was the fifty-seventh convention.

DR. WALTER C. COFFEY, acting president of the University of Minnesota since the retirement on June 30 of President Guy Stanton Ford, has been elected the seventh president of the university. He will have approximately two and a half years in office before reaching the retiring age of sixty-eight years. Dr. Coffey has for twenty years held the position of dean and director of the university department of agriculture.

DR. HARRY NOBLE WRIGHT, acting president of the

College of the City of New York, has been recommended for the presidency by the Board of Higher Education. He will succeed Dr. Frederick B. Robinson, who resigned in June, 1939. Dr. Wright has been a member of the faculty of mathematics since 1931. He had previously been dean and president of Whittier College, Calif., and dean of Earlham College, Richmond, Ind.

DR. WILLIAM CARSON VON GLAHN, of the College of Physicians and Surgeons of Columbia University, associate professor of pathology, has been appointed professor of pathology at New York University College of Medicine and director of the department of pathology and laboratories at Bellevue Hospital.

DR. T. T. CHEN, research associate in zoology at the University of California at Los Angeles, has been appointed lecturer.

RAFAEL E. PONTIS, director of the government laboratory of phytopathology at Mendoza, Argentina, has joined the division of plant pathology of the University of California College of Agriculture as research fellow.

C. FOSTER WRAY has been made temporary custodian of the anthropological collections at the Rochester Museum of Arts and Sciences. He will supervise the removal of the collections to the new building of the museum.

DR. E. S. NASSET, associate professor of physiology, department of vital economics of the University of Rochester, and Dr. R. G. Daggs, associate professor of physiology at the College of Medicine, University of Vermont, have been appointed majors in the Sanitary Corps for service in the Food and Nutrition Division of the Medical Department of the Army. They are now at the Army Medical Center in Washington, D. C.

PROFESSOR JAMES G. NEEDHAM, of Cornell University, is visiting Stanford University in order to prepare for a collecting trip in the Olympic Mountains in the spring.

ACCORDING to the *Journal* of the American Medical Association, Dr. Ragnar T. Westman has resigned as health director of Kansas City to assume rank as surgeon of the U. S. Public Health Service and serve as federal consultant in epidemiology to extra cantonment and defense areas. He is stationed in Bethesda, Md.

*Nature* states that Sir Franklin Sibly, vice-chancellor of the University of Reading, has been appointed a member of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research. The Right Hon. Viscount Fal-

mouth has retired from the council on completion of his term of office.

*The Lancet* announces that a dietetic council has been set up in Ireland "to experiment on ways and means of aiding the people's nutrition under war-time conditions, paying special attention to children's diet." The following have been appointed: Dr. P. T. O'Farrell (chairman), Professor W. J. E. Jessop (secretary), Professor W. R. Fearon, Dr. Catherine O'Brien, Dr. John Mowbray and Dr. Oliver Fitzgerald.

DR. TRACY J. PUTNAM, professor of neurology and neurosurgery at the College of Physicians and Surgeons, Columbia University, gave a lecture in the series for the laity of the New York Academy of Medicine on December 11. He spoke on "The Mechanisms of the Mind."

DR. STANHOPE BAYNE-JONES, professor of bacteriology in the Yale University School of Medicine, will deliver, on January 23, the eighteenth Ludwig Hektoen Lecture of the Frank Billings Foundation of the Institute of Medicine of Chicago. The subject of his lecture will be "Tetanus."

DR. A. G. McNISH, of the department of terrestrial magnetism of the Carnegie Institution, gave an address, on December 6, at the annual meeting of the Philosophical Society of Washington. He spoke on "Great Geomagnetic Storms of the Present Sun-Spot Cycle."

DR. HAROLD E. BURTT, professor of psychology at the Ohio State University, addressed the University of Cincinnati Chapter of the Society of the Sigma Xi on December 3, on "Psychology's Contribution to Scientific Crime Detection."

DR. EDWARD TELLER, professor of physics at George Washington University, who was recently appointed visiting professor of physics at Columbia University, delivered, on December 9, the annual public lecture before the Columbia University Chapter of the Society of the Sigma Xi. This lecture was entitled "Energy Production in Stars."

THE annual meeting of the Metropolitan New York Section of the Mathematical Association of America has been set for April 18, at Hunter College in New York City.

THE Soil Science Society of Florida held the fourth annual meeting in Gainesville on December 5 and 6. There were three half-day sessions at which fourteen papers were presented. Soil research, with special emphasis on Florida agriculture, plant food, soil and water conservation, and Inter-American agricultural education and research were discussed.

"SCIENTIFIC Planning in Defense Production" was

the subject of a conference in New York on December 13. The conference, conducted under the sponsorship of the American Association of Scientific Workers, was the first of an important series of similar meetings to be arranged by the association in Boston, Chicago and other cities for the purpose of interesting a larger group of scientific and technical workers in methods of participating more actively in defense and of drawing wider public attention to vital problems of national significance. The conference consisted of reports by speakers followed by discussions from the floor. The program was as follows: *Mineral Resources*—Professor C. H. Behre, department of geology, Columbia University; *Power*—P. W. Swain, editor, *Power*; *Machinery*—John Haydock, managing editor, the *American Machinist*; *Utilization and Training of Personnel*—Dean Albert B. Newman, School of Technology, College of the City of New York; *Organization and Planning*—Dr. Harlow S. Pearson, a former president of the Taylor Society. Professor Walter Rautenstrauch, of the department of mechanical engineering, Columbia University, is chairman.

DUE to the present uncertainty of delivery, issues of the *Rivista di Parassitologia*, Rome, are being stored for all foreign subscribers and exchanges. This practice will be continued until a return of normal conditions, unless the publishers are requested to mail the issues at the subscriber's risk.

A NEW joint university library to serve Vanderbilt University and Peabody and Scarritt Colleges was dedicated in Nashville on December 5 and 6. This library, designed as a step toward the realization of a great regional university center in Nashville, was established to eliminate unnecessary duplication and to coordinate and expand the library resources and services of the three institutions. Erected on a plot of ground connecting the three schools, the new library is designed to house 550,000 volumes and is so planned that its initial capacity can be increased to a million books by expanding the center of the structure. The building and its endowment represent an investment of approximately \$2,000,000, half of which came as a grant from the General Education Board, a substantial sum from the Carnegie Corporation and the remainder from more than 5,000 students, faculty members, alumni, employees and friends.

SUPREME COURT JUSTICE LOUIS A. VALENTE refused on November 17 to restrain Park Commissioner Robert Moses from keeping the Aquarium in Battery Park, New York City, closed, but said that an application for an injunction might be renewed in the future, "should subsequent developments disclose that the Aquarium building is being raised or damaged without the proper authority of the Board of Estimate." In denying the

restraining order sought by Pierce T. Wetter, treasurer of the Greenwich Village Historical Society, Justice Valente upheld the right of Commissioner Moses to close the building temporarily to prevent accidents during construction of the Brooklyn-Battery tunnel, but indicated that a permanent closing might be a different matter.

SIMON GUGGENHEIM, president of the American Smelting and Refining Company and formerly United States Senator from Colorado, who died on November 2, left nearly all his estate to "The John Simon Guggenheim Memorial Foundation" established by him and his wife as a memorial to their son, who died in April, 1922. The foundation was created in 1925 to "promote the advancement and diffusion of knowledge and understanding and the appreciation of beauty." Among other bequests are the sum of \$200,000 to the University of Colorado and \$100,000 to the School of Mines at Golden, Colo., to which he had given \$80,000 when his son was born.

By the will of Frank Graham Thomson, who died in September, Harvard University will receive eventually the sum of \$750,000 which it is suggested should be used for "training young men for the Federal Service of the Government of the United States." Mrs. Thomson will receive the income of the fund so long as she lives; on her death the fund will go to the Harvard department of government.

It is reported in the *Journal* of the American Medical Association that Swift and Company, Chicago, has announced the establishment of a series of fellowships for research in nutrition. Intended to aid the Federal Government in its long-range national program in nutrition, the fellowships provide for special research to be undertaken in laboratories of universities and medical schools with funds set aside by Swift and Company as grants-in-aid, beginning on November 1. The fellowships will be for one year but may be renewed when the project warrants it. Any fundamental study of the nutritive properties of foods or the application of such information to improvement of the American diet and health will be eligible for consideration for a grant. Placement of the new fellowships will be coordinated by R. C. Newton and his staff of the Research Laboratories of Swift and Company, Union Stock Yards, Chicago.

IN accordance with the desire of the late Dr. A. C. Langmuir, Mrs. Langmuir has presented five hundred volumes from his library to the Boyce Thompson Institute for Plant Research at Yonkers, N. Y. Many books in excess of the five hundred volumes were presented to other institutions, either because they represented phases of science not covered at the institute or because duplicates were already in its library.

THE John Wesley Hyatt Award, a gold medal and a thousand dollars, to be made annually to the individual rendering the most distinguished service in the field of plastics, has been established by the Hercules Powder Company, manufacturers of the basic raw materials used in the plastic industry. Its administration is in the hands of an Awards Committee, including Richard F. Bach, Metropolitan Museum of Art, New York; Dr. Lyman J. Briggs, director of the National Bureau of Standards; Dr. Karl T. Compton, president of the Massachusetts Institute of Technology; Watson Davis, director of Science Service, Washington; Dr. Harry N. Holmes, Oberlin College, president-elect of the American Chemical Society, and Eric Hodgins, publisher, *Fortune*, New York. L. T. Barnett, editor of *Modern Plastics Magazine*, is secretary of the committee. John Wesley Hyatt, for whom the award is named, was a pioneer in the plastics industry.

THE cornerstone of the building for the new laboratories at Princeton, N. J., of the Radio Corporation of America was laid on November 15 by General J. G. Harbord, chairman of the board of the corporation. The speakers included Dr. David Sarnoff, president of the corporation, who spoke by radio from the *S. S. Matsonia en route* from Honolulu to San Francisco, and Dr. Gano Dunn, member of the Board of Directors. Otto S. Schairer, vice-president in charge of the laboratories, presided. In laying the corner-

stone, General Harbord sealed into place an air-tight lead box containing radio and electronic devices, as well as literature, representative of current development in the radio age. Included among the contents were an iconoscope and a kinescope, a cathode-ray tube, several new and special types of electronic tubes, a microphone, a loudspeaker and the latest design of a personal radio receiver.

THE Oregon State Board of Higher Education recently approved the restoration of courses leading to graduate and undergraduate degrees in six scientific divisions at the University of Oregon. The degrees will be offered, beginning with the academic year of 1942-43 in mathematics, chemistry, physics, geology, botany and zoology. In 1932 the board transferred all major work in science to Oregon State College as a part of the program of unification and prevention of duplication in the curriculum of the centralized Oregon system of higher education. Service courses in all the branches of science for lower division work were retained at the University of Oregon. In granting the request of the university that the department of science be restored, the committee on curricula of the board pointed out that the request of the university was reasonable and would strengthen the whole system of higher education. It was further stated that for a university to perform its educational function, it must have a complete college of liberal arts, including the sciences.

## DISCUSSION

### ON THE PRECISION OF ESTIMATES FROM SYSTEMATIC VERSUS RANDOM SAMPLES

IN recent years marked advances have been made in increasing the efficiency of sampling through the development of modern theories of mathematical statistics, which has led to the more wide-spread use of stratified random sampling. It has been possible, in many instances, to effect considerable reductions in the variation to which sample estimates of population parameters are subject by a knowledge of the population to be sampled and a judicious choice of the strata from which the samples are to be drawn.

Gains in efficiency through this kind of restriction have been limited, however, in three ways, i.e., (1) by the extent to which the population to be sampled is stratified, (2) by the size of the sample and additional cost of selecting observations by strata, which determine the extent to which advantage can be taken of the existing stratification, and (3) by the requirement imposed by the mathematical model, upon which error formulae are based, that there must be at least two independently and randomly selected observations in each of the strata sampled. This requirement, which

appears to be inconsequential, turns out in actual tests to have a quite serious effect.

A large part of the work of the U. S. Forest Service, whether it be research, administration or land-use planning, requires sampling, to provide estimates of timber volume, forage, infiltration capacity or other characteristics of the land and its cover. Also, basic to many of these sample estimates, is an estimate of the area in each of the recognized cover types. In this sampling work, one of two systematic methods of selecting the samples has usually been employed. These are the line-plot and strip methods of sampling, by which evenly spaced plots along evenly spaced lines are observed, or evenly spaced strips are used as plots. It is evident that selection of plots in either of these two ways does not satisfy the requirement of independence and randomness and that, therefore, data so obtained do not provide a valid estimate of sampling errors when random sampling error formulae are used. In considering revisions of these sampling schemes, it is important to know the extent to which substitution of methods of sample selection allowing straightforward calculation of sampling errors affects the precision of sample estimates. More

specifically, what is the effect of introducing the requirement that there be at least two randomly chosen observations in each stratum sampled?

To answer this question, tests were made of cover type estimates. These showed unmistakably that the removal of this requirement and selection of the observations in a systematic manner resulted in gains in efficiency; these frequently amounted to more than 100 per cent.

An understanding of the source of this gain in efficiency rests upon recognizing that the great bulk of the populations sampled, particularly in biological and social-science investigations, are not segregated into well-defined strata that are homogeneous within their boundaries, but, rather, vary continuously in much the same fashion as elevations or fertility levels in a field. Therefore, even though individuals in selected subregions of a population tend to be high, or low, as compared with those in other subregions, it will be found upon investigation that, even within subregions, there will be continuous trends of the variate measured, and that the changes between adjacent subregions is continuous in the transition zone encompassing the subregion boundaries. When this is recognized, it becomes apparent that sampling in many populations in place or time reduces to a problem of estimating the ordinates or the integral of a single-valued continuous curve. It is also evident from this that uniformly spaced observations will yield a better representation of this curve than will observations that are restricted only to the extent that when the range of the abscissae of the curve is divided into  $\frac{n}{2}$  equal parts, two of the  $n$  observations fall in each part. With this restriction, many of the observations may fall so close together that two or even three observations supply little more information concerning the curve than does a single observation. Upon more thorough consideration it will be evident that the gain in accuracy, as measured by the expected variation among systematic sample totals or means, arises also from a usually high correlation among them. That is, when the results of a single sample, so selected, are available, the results of any other such sample can be predicted with considerable precision.

To furnish an estimate of the precision of this prediction requires obtaining two rather easily calculated statistics, namely, estimates of the error variance of a single observation and of the correlation between the ordinates measured and the ordinates to be predicted. The first is estimated by the residual mean-square error from a polynomial fitted by the method of least squares. Since the observations are evenly spaced and of equal weight, this is most readily accomplished by use of orthogonal polynomials, the

fitting process being continued until additional fitted constants no longer reduce the residual mean-square significantly as adjudged by Snedecor's  $F$ . To estimate the correlation coefficient, it is necessary to calculate the correlation between observations, in the original sample, that are separated by one unit, two units, etc., and to fit a curve to the observations of the correlation coefficient and the distance between observations. This curve is controlled in that at zero distance the correlation coefficient is equal to one. With the data used in this study, a curve of the form  $r = e^{-kd}$  where  $r$  is the correlation coefficient,  $d$  is the distance and  $k$  is an arbitrary constant, was usually sufficient to represent the data. From this curve, which may be converted to a curve of  $(1 - r^2)$  over distance, the average value of  $(1 - r^2)$  for all possible systematic samples selected in the same way can be estimated. The average squared error of estimate thus is calculated as  $s^2 \overline{(1 - r^2)}$ , where  $s^2$  is the residual mean square from the polynomial and  $\overline{(1 - r^2)}$  is the average  $(1 - r^2)$  as defined above.

JAMES G. OSBORNE

U. S. DEPARTMENT OF AGRICULTURE

### EXTRA STRONG HELIOTROPIC EFFECT OF NEON LIGHTS

IN Texas there is an annual swarming of insects to city lights, which begins at the time late in August when the first break in the excessive summer heat occurs. During all the rest of the year none of these species are to be seen on the city streets.

Then one evening a few cool breezes arise from the north, and that night countless thousands of flying black field crickets descend on the towns. These last for a few nights, and then disappear. A week or so later a similar horde of small black and narrow hard beetles cover buildings around light fixtures. Later an army of odorous small green bugs descend on the towns. These annually recurring visitations have been noticed with interest by the writer for a great many years. During all these years the concentration of insects around lights varied only with the position and intensity of the visible white light rays emitted by the ordinary street and business illuminations.

In the last few years a striking change has been noted in the objects of their attentions. With the installation of numerous neon lights throughout the business district the insects have almost ignored the ordinary white street lights which formerly were covered with them, and which would be seen first in their flight in from the country, and have collected in vast numbers on the neon signs down town.

This selectivity is shown strikingly where a brilliantly white lighted store shows comparatively few insect visitors and another beside it with neon signs is black with countless thousands.

This preference could hardly be a manifestation of ordinary heliotropism, because many of the white illuminations are much stronger in visible light than those which attract the insects.

One new set of visitors came this year—a great influx of brown moths. Thus far the green bugs have not arrived.

If the insects were mainly of varieties normally attracted by bright-colored flowers, one might assume that the superior attraction rested in the color; but this is not the case, with the exception of the moths.

The idea then occurs that possibly neon lights may emanate invisible rays which connect with the antennae of various insects and pull them to its source. If this be true and the radiations can be identified and suitable projectors manufactured, this might be a solution to the problem of crop pest eradication. It may be that different vibrations attract different species, but the evidence seems to indicate that neon lights give off rays which strongly attract insects of widely different types and that this attraction is many times more powerful than that produced by white light.

CYRUS N. RAY

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### COLOR SYSTEMS

THE Ridgway Colors and Nomenclature have been found quite practical for years by biologists, in particular mycologists and ornithologists, for the description of color and at the present time there are many references to Ridgway in the literature. However, an improved system is desirable as the Ridgway colors alter with age and are not reproducible.

Time and the work of many investigators has now shown that the Munsell Color System and notation of Professor A. H. Munsell is well established.<sup>1,2</sup> While the chips of the Munsell Color Book are not absolutely permanent, they are sufficiently stable to withstand normal usage, and a conversion table has now been published which gives the Munsell colors in terms of

the ICI (1931) *xy* coordinate specification system which is based on absolute standards.

The large number of Ridgway color chips have simplified comparison and identification of colors. Although the number of Munsell colors is smaller the arrangement, even in the abridged book of color, makes possible close estimation. The alternative color arrangements of the standard book serve for closer checking.

Field work is facilitated, since the Munsell system is based on three distinct dimensions: hue, gray value and saturation (chroma). This makes possible the broad description of colors without comparison with standards, for the observer can readily indicate the limits of color range when he is doubtful.

D. H. HAMLY

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### REPRINTS FOR EUROPEAN LABORATORIES

IN SCIENCE for November 7, Robert B. Dean suggests that since European laboratories are unable to obtain American or British scientific journals, reprints be sent by American scientists instead. Such reprints may reach certain laboratories, but not all. Since November, 1940, reprints and personal letters addressed to various scientists in occupied France have uniformly been returned with the notation that service has been suspended. Recently letters to Barcelona have been returned the same way. Reprints and correspondence seem to reach Belgium, Holland and the Scandinavian countries satisfactorily, and also Switzerland. Nothing, however, seems to get into or out of what was Czecho-Slovakia, Poland, Yugoslavia or Greece. There seems little use in wasting funds on shipments of reprints to these portions of Europe if the material is returned due to what appears to be a Nazi policy of intellectual as well as physical starvation.

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## QUOTATIONS

### A METONIC SPAN IN THE WORK OF THE CARNEGIE CORPORATION

METON was an Athenian astronomer of the fifth century B.C., remembered chiefly because of his division of time into nineteen-year periods. The writer, it must be confessed, first learned of his existence at

<sup>1</sup> See the five papers on the Munsell color system and bibliographies as published in *Jour. Opt. Soc. Amer.*: 573-645; December, 1940.

<sup>2</sup> J. J. Glenn and James T. Killian, *Jour. Opt. Soc. Amer.*: 609-616; 1940.

the recent installation of Dr. John W. Nason as president of Swarthmore College through reference to the Metonic span of nineteen years' service by the retiring president, Dr. Frank Aydelotte. Since his own final report must of necessity deal rather with past experience than with future plans, and since the day of his retirement in November, 1941, also brings to a close a Metonic span in the service of the Carnegie Corporation, the writer has adopted the term as the subtitle of the concluding section of this report.

In 1922, the beginning of this particular Metonic span, American foundations had already made their place. The capital funds at their disposal had reached vast figures, and the sums distributed under the terms of their charters were correspondingly impressive. The Carnegie Corporation alone had voted more than \$88,000,000, including a single gift of \$5,000,000 to the National Research Council for building and endowment. Outstanding achievements were already to their credit: by the Rockefeller Foundation in public health and medical education, by the General Education Board in education in the South, by the Carnegie Corporation in library construction, by the Carnegie Institution of Washington in scientific research. In a number of fields foundations had developed influential leaders. They were in a position to enlist distinguished men as members of their boards of trustees, and under the able executives who had been called to their direction the foundations were becoming clearing houses for ideas, an educational service whose importance is often overlooked.

Throughout the Metonic span the attitude of the foundation has reflected the current intellectual and moral climate of the country; 1922 was a day of confidence and buoyancy. It was a day of big things with as yet unshaken confidence in what money could perform. Foundations enjoyed a large and steady income. The path ahead seemed clear. The Carnegie Corporation was carrying a load of over \$40,000,000 voted against future income, cheerfully unaware of the gruelling but necessary task lying before it of reducing that load to its present figure.

The chief recipients of foundation grants were the endowed colleges and universities. State institutions were relatively neglected. Grants were mostly devoted to endowment for general purposes or to buildings. Only one profession, medicine, enlisted the interest of foundations, but this profession received immense sums. Large funds were given to a new type of independent non-teaching institution, for example, the Food Research Institute in Palo Alto, the Institute of Economics in Washington and the American Law Institute in Philadelphia.

In addition to institutional gifts, the foundations encouraged elaborate and expensive proposals for general studies, surveys and demonstrations, in which the recently developed techniques of educational and social measurement and appraisal were at times applied with more zeal than judgment. Under the stimulation of the World War I certain agencies concerned with social problems had built up large budgets and undertaken extensive programs; they had enlisted the services of ambitious and energetic officers who succeeded in persuading the foundations to contribute to the carrying out of their plans.

The conditional gift was in general favor. It fitted into the spirit of the times, and individual donors or other trusts could readily be found to comply with the requirements. Many such gifts were made in response to a series of institutional drives conducted under professional direction. For example, the finances of many colleges were strengthened by the joint action of the General Education Board and Carnegie Corporation in voting conditional grants for endowment.—*Dr. Keppel in his final report as president of the Carnegie Corporation.*

#### PROGRESS AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

ALONG with maintaining our normal educational activities we have been able to initiate or put into effect some highly significant additions and improvements in our facilities and educational programs. Many of these have already been separately reported to the Corporation Visiting Committees since they resulted from recommendations made by these committees, and I will attempt here to brief only some of the most noteworthy ones.

For a number of years the visiting committee of our medical department repeatedly has recommended the addition of both a dental clinic and a psychiatric clinic to our medical service. During the year the Charles Hayden Foundation, upon recommendation of Mr. Willard Hayden, made a grant of \$10,000 to equip and start a dental clinic which is now in operation. With the opening of school this fall we also initiated a psychiatric service. A physician trained as a specialist in this field is available for consultation and other services for a two-hour period twice a week.

Last January the corporation authorized a new degree, doctor of philosophy in industrial economics, based upon a new program of graduate study and research in the social sciences. Subsequently friends of the institute have contributed \$8,000 for fellowships in this field, and last month the Rockefeller Foundation authorized a grant of \$30,000, payable over three years, for a research study of the economic effects of technological change. This research, which requires a combined technological and economic approach, will seek to clarify the role of invention in the business cycle and will involve investigation of factors in an individual firm influencing technological change together with case studies of the effect of inventions on labor policies.

These developments reflect the steady growth of our work in social studies, particularly in relation to the economic and labor problems of industry. Our very active industrial relations section, which was established three years ago and which has been generously supported by industry, will play an important

part in this new program of professional training and research.

Our biological engineering program, which went into full gear this past summer under the direction of its new head, Dr. Francis Schmitt, has received an additional grant of \$70,000 from the Rockefeller Foundation for the establishment of a sub-microscope center for studying the application and improvement of the electron microscope, particularly in the biological field.

Recent years have brought increased emphasis at the institute on industrial or applied mathematics and the more extensive application of mathematical techniques to special problems. One example of this is our center of analysis, which provides a wide range of machines for the analysis of technical problems. The new differential analyzer, the major unit in this

center and one of the great scientific instruments of modern times, is now nearing completion. In still another direction, a laboratory has been established for the application of mathematical statistics to industrial problems, particularly to quality control. The department of mathematics and the department of economics and social science have joined forces in this program, and they are assisted by a group of cooperating companies which by their support are aiding fundamental research in this field while at the same time receiving assistance from our specialists in the solution of specific problems. As the role of the applied mathematician becomes more defined and recognized we plan the establishment of a more formal program of instruction in the field.—*From the annual report of Dr. Karl T. Compton, president of the Massachusetts Institute of Technology.*

## SCIENTIFIC BOOKS

### FRANKLIN'S EXPERIMENTS

*Benjamin Franklin's Experiments.* Edited with a critical and historical introduction, by I. BERNARD COHEN. Cambridge, Massachusetts: Harvard University Press, 1941.

THIS book contains those writings of Benjamin Franklin which present his theories and observations in what was in his time the new and almost unexplored field of electricity. Franklin's attention was directed to the subject by a Dr. Spence or Spencer whom he met in Boston in 1746. By a happy coincidence the Library Company of Philadelphia, of which he was an active member, received about this time from its London correspondent, Mr. Peter Collinson, F.R.S., the present of a glass tube, with some directions for its use in making electrical experiments. Franklin had lately arranged his affairs so that he was no longer engaged in active business, and he was free to throw himself with ardor into the study of this new and fascinating subject. Apparently he was unacquainted with its literature and knew little of what had been done in Europe. He must have been informed of the performance of the Leyden jar, but in practically all his work he relied on his own observations and made his own theories. He gave them to the world in the form of letters, most of which were sent to Mr. Collinson, and were read by him to the Royal Society and published in its Transactions. They were afterwards collected and published in several successive editions, from the fifth of which the text of this edition is taken. These letters were widely read both in English and in French, German and Italian translations, and gave Franklin a reputation as a thinker which served him well when he entered public life.

It would be idle to attempt to decide on the question

of Franklin's priority for his discoveries. So many men were working and playing with the electric spark and the Leyden jar, and the communication of their results was so uncertain and often so long delayed, that it is probable that many of the important facts were discovered again and again. We can be sure, though, that Franklin's work was independent and original. His most important achievements were the discovery of the way in which electricity streams from or to a point; the discovery of the way to charge an insulated conductor by induction; the recognition from this experiment that electricity is not produced by the act of friction but is merely altered in distribution; the satisfactory analysis of the charging of the Leyden jar; and the demonstration that lightning is an electric discharge. In describing these results he uses the hypothesis that there exists in all bodies an electric fluid, ordinarily in a normal or passive condition, and that the act of charging a body gives to it a surplus of this fluid, which is taken from other bodies. The one body has a positive charge, the other bodies a negative charge. He is puzzled by the fact that two negatively charged bodies repel each other, but seems to be willing to accept the fact without explanation. This one fluid theory, as it was called, in distinction from DuFay's two fluid theory, which had been announced a few years earlier, and which Franklin does not seem to have known, was for a while the prevalent theory and has left its mark in the nomenclature of the subject.

In a valuable Introduction of 160 pages—the text of Franklin's papers, with some supplementary matters, takes up about 275 pages more—the editor indicates his belief, based on some expressions of Franklin in private letters, that he was essentially a scientist

and that he always regretted that he had been drawn away by public business from more congenial pursuits. This may be true, but it is hard to believe that he would have chosen to spend his life manipulating glass tubes and Leyden jars in preference to managing men. There is given a very accurate and interesting account of the state of the science of electricity before Franklin, and a complete survey of Franklin's own work in the subject.

Then follows the text of those parts of Franklin's writings which have been selected by the editor to exhibit Franklin's discoveries in electricity, and a few letters on other subjects which show his scientific

methods. An appendix contains some account of the work of Franklin's collaborators, particularly that of his friend and follower, Ebenezer Kinnerley: also an amusing anonymous letter addressed to Franklin in 1777, "in which his pretensions to the title of NATURAL PHILOSOPHER are considered." The critic chiefly objects that Franklin does not employ the methods of Sir Isaac Newton.

The book is beautifully printed at the Harvard University Press, and reflects great credit on its editor and publisher.

W. F. MAGIE

PRINCETON, N. J.

## SPECIAL ARTICLES

### THE EXTRACTION OF BIOTIN FROM TISSUES

THE interest in biotin and the biotin content of tissues has been great in recent months, partly because of the possible relationship of this substance to malignancy.<sup>1,2,3</sup>

The first determinations of the biotin content of various tissues and materials were made simply by studying the content of the hot water extracts.<sup>4</sup> Subsequently the freeing of relatively large amounts of additional biotin by the autolysis, for example, of liver tissue was observed.<sup>5,6</sup>

In an earlier publication<sup>7</sup> and in a recent bulletin<sup>8</sup> from this laboratory the biotin content of tissue autolysates was investigated, supplemented in the latter case by a few separate determinations on acid hydrolyzed specimens. The treatment used in these latter determinations is now recognized to be inadequate.

The purpose of this report is to bring together and to extend some of the observations made in this laboratory with regard to the question of different natural combinations in which biotin appears to exist.

Six methods of extraction were first investigated on eight tissues. The methods of extraction were (1) cold water (15 minutes), (2) hot water (100° C. 15 minutes), (3) autolysis (24 hours at 37° C. under benzene), (4) acid hydrolysis (6N H<sub>2</sub>SO<sub>4</sub>, autoclaved

1 hour at 15 lbs. pressure), (5) enzymatic digestion (1 per cent. "clarase" plus 1 per cent. "caroid," figured on the basis of the moist tissue, for 24 hours at 37° under benzene), and (6) enzymatic digestion for 48 hours, otherwise identical to (5). The tissues extracted were egg yolk, dialyzed egg yolk, dialyzed egg white saturated with biotin (avidin-biotin complex), rat liver, rat muscle, rat brain, *Pseudomonas fluorescens* cells, and *Clostridium butylicum* cells. After extraction the solids were removed by filtration through a thin mat of kieselguhr and the biotin content of the extracts determined by the method of Snell, *et al.*<sup>5</sup> The results are shown in Table I.

TABLE I  
BIOTIN YIELDS BY DIFFERENT TREATMENTS (γ/GM. DRY WT.)

	Cold water	Hot water	Autolysis	Acid hydrolysis	24 hr. enzyme	48 hr. enzyme
<i>Clostridium butylicum</i> . . . . .	.00048	.00098	.0046	.52	.62	.69
<i>Pseudomonas fluorescens</i> . . . . .	.041	.068	.130	2.70	.77	1.19
Egg yolk . . . . .	.018	.081	.088*	.41	.32*	.33*
Egg yolk, dialyzed . . . . .	.029	.41	.27*	.50	.36*	.48*
Egg white-biotin, dialyzed . . . . .	.16	4.90	.21†	8.10	.17†	.17†
Rat liver . . . . .	.028	.056	.53	2.30	2.00	3.10
Rat brain . . . . .	.0033	.0077	.0058	.27	.14	.22
Rat muscle . . . . .	.0050	.0098	.0036	.11	.061	.098

\* Heat sterilization was used in these and other cases not indicated.

† No heat sterilization was used in these cases.

It will be noted that acid hydrolysis under the conditions employed freed the maximum amount of biotin except in two cases in which enzymatic treatment yielded up to 35 per cent. more. Longer digestion with acid increases the yield (see Table II). If we consider the largest amount freed as the total amount present, the proportion freed by autolysis varies from 0.7 per cent. in the case of *Clostridium butylicum* up to 18 per cent. for rat liver. It is interesting that the *clostridium*, which is unable to synthesize

<sup>1</sup> P. M. West and W. H. Woglom, *SCIENCE*, 93: 525, 1941.

<sup>2</sup> W. L. Laurence, *SCIENCE*, 94: 88, 1941.

<sup>3</sup> V. du Vigneaud, Symposium on Vitamins, Chicago, September, 1941.

<sup>4</sup> P. Kagi and W. van Hasselt, *Zeits. physiol. chem.*, 243: 189, 1939.

<sup>5</sup> H. E. Snell, H. E. Eakin and R. J. Williams, *Jour. Amer. Chem. Soc.*, 62: 175, 1940.

<sup>6</sup> György and coworkers found "vitamin H" freed by autolysis of yeast but not of liver. *J. Biol. Chem.*, 131: 733 and 743, 1939.

<sup>7</sup> H. E. Eakin, W. A. McKinley and R. J. Williams, *SCIENCE*, 92: 224, 1940.

<sup>8</sup> The University of Texas Publication, No. 4137, 1941.

biotin, does not contain autolytic enzymes to free it from combination. The relatively large proportion of biotin extracted from the egg white-biotin and the dialyzed egg yolk by hot water is notable.

From separate experiments not included in the table, it appears that biotin is much less completely freed from exhaustively dialyzed egg yolk by enzymatic treatment, than from undialyzed egg yolk. On the other hand, exhaustive dialysis of egg yolk renders biotin available for yeast in that even a cold water extract contains it in considerable amounts in an effective though non-dialyzable form. Dialysis of liver tissue does not render the biotin available (cold water), but enzymatic treatment of the dialyzed material frees the active substance to a considerable degree.

From the data in Table I it would appear that acid hydrolysis was in general the most effective extraction procedure. To study this further a series of acid and alkaline hydrolyses for different lengths of time were carried out on beef liver, beef heart muscle and *Clostridium butylicum* cells. The results of these experiments are recorded in Table II.

TABLE II  
BIOTIN YIELDS BY ACID AND ALKALINE HYDROLYSIS  
( $\gamma$ /GM. DRY WT.)

	<i>Clostridium butylicum</i>	Beef liver	Beef heart muscle
6N H <sub>2</sub> SO <sub>4</sub> , 120° C, 1 hr.	.84	2.90	.43
" " " 2 hr.	1.10	3.25	.49
" " " 5 hr.	.98	3.45	.49
" " " 10 hr.	1.05	2.90	.46
6N HCl, 120° C, 1 hr.	1.10	3.45	.46
" " " 2 hr.	1.10	3.35	.49
" " " 5 hr.	1.10	3.25	.43
" " " 10 hr.	.91	2.90	.44
6N NaOH, 120° C, 1 hr.	.77	2.55	.34
" " " 2 hr.	.49	1.60	.20
" " " 5 hr.	.32	.46	.09
" " " 10 hr.	.24	.35	.00
18N H <sub>2</sub> SO <sub>4</sub> , 120° C, 2 hr.	.74	2.90	.31

It will be seen immediately that alkaline hydrolysis is unsuitable, since it brings about a gradual destruction of the biotin. Sulfuric acid (6N) frees the maximum amount of biotin only after from two to five hours at 120° C. Hydrochloric acid (6N) appears to be somewhat more effective, the maximum amount of biotin being obtained after one or two hours. Some destruction of the biotin takes place with both HCl and H<sub>2</sub>SO<sub>4</sub> on prolonged heating, although even with 18 N H<sub>2</sub>SO<sub>4</sub>, autoclaving for two hours results in a destruction of only from 20 to 40 per cent.

It appears that for many materials the surest method for extracting biotin consists in drastic acid hydrolysis, and on the assumption that the extraction is complete, the biotin content of rat and beef liver is about 3.5  $\gamma$  per gram of dried tissue. This is about 1,000 times that originally found by Kögl and

Hasselt<sup>4</sup> and agrees substantially with the values of West and Woglom.<sup>1</sup>

Biotin appears to occur naturally in different combinations which are broken down with varying degrees of ease. A study of these will be necessary before the functioning of biotin can be clarified.

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## FLIES AS CARRIERS OF POLIOMYELITIS VIRUS IN URBAN EPIDEMICS<sup>1</sup>

THE recent accumulation of data suggesting that human poliomyelitis is primarily an infection of the alimentary tract with secondary localization in the central nervous system<sup>2</sup> has led to a renewed consideration of the possible role of flies in the transmission of this disease. Several groups of investigators have undertaken to search for the virus in flies caught during the course of various outbreaks of poliomyelitis this summer. Paul, Trask and their collaborators<sup>3</sup> have just reported the isolation of poliomyelitis virus from flies caught in 2 rural areas: (1) in a camp in Connecticut where several cases had occurred and (2) in Alabama near a privy used by three households where cases of poliomyelitis had recently occurred.<sup>4</sup> During the latter part of July and August we caught flies in 16 different urban sites during outbreaks of poliomyelitis in Atlanta and Cleveland. Because monkeys were not available the tests were not carried out till 10 to 12 weeks later, during which time the flies were kept in the frozen state in an insulated box containing solid CO<sub>2</sub>. Although all the specimens have not yet been tested, we have already obtained 3 positive results: two with specimens caught in Cleveland and one with a small number of flies caught in Atlanta.<sup>5</sup>

The first specimen of flies to yield the virus has a rather interesting history. The site where the trap was set out was a government housing project consisting of modern, clean, thoroughly screened and hygienic homes situated on a hill in the center of Cleveland. There was a special brick enclosure for

<sup>1</sup> Aided by a grant from The National Foundation for Infantile Paralysis, Inc.

<sup>2</sup> A. B. Sabin and R. Ward, *Jour. Exp. Med.*, 73: 771, 1941; A. B. Sabin, *Jour. Am. Med. Ass.*, 117: 267, 1941.

<sup>3</sup> J. R. Paul, J. D. Trask, M. B. Bishop, J. L. Melnick and A. E. Casey, *SCIENCE*, 94: 395, 1941.

<sup>4</sup> Dr. John A. Toomey has just informed us that he has detected poliomyelitis virus in 2 specimens of flies caught in rural areas near Cleveland; one was trapped near an open privy 15 miles from the city and the other near a creek containing sewage just outside of town.

<sup>5</sup> Since this paper has been submitted for publication we have demonstrated the presence of poliomyelitis virus in two additional specimens of flies caught in two different regions of Cleveland during August 9 to 12 and August 14 to 16 respectively.

the garbage cans, all of which were covered. Two children who developed poliomyelitis on August 7 and 9, respectively, were admitted to the City Hospital on August 11 from one of these homes. Investigation on August 16 revealed that 2 of 4 siblings had been ill for one day (August 4) with signs and symptoms suggestive of abortive poliomyelitis and that between August 7 and 13, 7 other children in the homes facing on the same yard had minor illnesses compatible with a diagnosis of abortive poliomyelitis. There was also the story that about a month before (early in July when only a few cases of poliomyelitis had been reported in Cleveland) after a severe storm the sewage overflowed, ran down the street, and some of the children became contaminated in the course of play. There were so few flies about that it hardly seemed worth while to set out a trap. However, about 500 flies (not identified as to species—mostly large green ones and many house flies) caught between August 16 and 18 yielded the virus upon inoculation into a *Cynomolgus* monkey. An etherized extract was injected intraperitoneally, and the unetherized material was given both intranasally and by mouth. The monkey developed paralysis on the 9th day and was sacrificed on the 10th day when all extremities were affected. Typical neuronal and infiltrative lesions were present in the spinal cord and passage to another *Cynomolgus* monkey resulted in flaccid paralysis on the 5th day and prostration on the 6th day. Histologically, this passage monkey exhibited necrosis and neuronophagia of practically all nerve cells in the spinal cord with typical infiltrative lesions. This virus was not pathogenic for mice, guinea pigs or rabbits.

The second positive result with a Cleveland specimen was with flies caught in the back yard of a private home (many miles from first site at the other end of town) in which 3 children of one family developed poliomyelitis between July 25 and July 30; two were removed to the hospital on July 30 and one on August 4. The home was fairly clean inside, with suitable toilet facilities, but it housed 7 other siblings, 2 of whom had had questionable minor illness. Four other

children in adjacent homes gave histories of having had minor illness compatible with abortive poliomyelitis between August 1 and 10. There were open garbage cans in the neighbors' back yard and many flies were present. A large number of flies were caught in our trap, which was set out in the yard between August 9 and 12. Material from a specimen weighing 31 gm and consisting mostly of large green flies, some small house flies and one bee produced paralysis (confirmed by positive histological findings) in a *Cynomolgus* monkey on the 9th day.

The Atlanta specimen weighed only 2.5 gm and consisted of 203 small house flies, 3 green flies, 2 large black flies, one moth, 1 caterpillar and one unidentified 4-winged insect. It was collected between July 30 and 31 and represented a pool of insects caught in two places, one more or less in the center of town and the other on the outskirts. One case of paralytic poliomyelitis occurred in each home, but the children had been in the hospital since July 18 and July 14, respectively. The inoculated *Cynomolgus* monkey became paralyzed on the 15th day and exhibited poliomyelitic lesions in the spinal cord and medulla. Passage into another *Cynomolgus* monkey resulted in paralysis on the 6th day. The virus was not pathogenic for mice.

The ease with which poliomyelitis virus can thus be isolated from flies caught in urban areas (where immediate contamination with feces in open privies is at least not obvious) suggests that they may play an important role in transmission of the virus and may perhaps be responsible for the special seasonal incidence of the disease. Among the many problems which these findings raise for future investigation, the question of whether or not the virus may actually multiply in the flies deserves the most careful attention.

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## SCIENTIFIC APPARATUS AND LABORATORY METHODS

### THE USE OF MERCURY IN CONTACT WITH AMMONIA

It has recently been called to the attention of the author that the use of mercury in contact with liquid ammonia or ammonia gas constitutes an explosive hazard, and that procedures involving the contact of these substances should be avoided. The author has been using mercury in contact with liquid ammonia

and ammonia gas in various ways for more than twelve years. He has found mercury to be a most convenient substance for certain uses with liquid ammonia, and he has never found any combination of the two substances to be explosive under the conditions of his experiments. Several other workers known to the author have also used mercury and ammonia in contact without explosive reactions occur-

ring. Franklin,<sup>1</sup> in his description of ammonio bases and basic nitrides, describes several explosive compounds that can be prepared in liquid ammonia. Among them is mercuric nitride, which detonates violently by impact or on being brought into contact with liquid water. Such compounds are generally prepared by metathetic reactions, however. He has recorded no reactions that might occur between metallic mercury and liquid or gaseous ammonia.

Two violent explosions that seem to have been caused by contact of mercury with ammonia have been described by Van Brunt<sup>2</sup> and by Henderson.<sup>3</sup> In both of these cases, however, the mercury was held in containers made entirely of iron or of iron and glass. Franklin<sup>1</sup> has not recorded any explosive compounds of iron that have been prepared in liquid ammonia, but he and several other workers, Ewan,<sup>4</sup> Miller and Roberts<sup>5</sup> and Nieuwland<sup>6</sup> have described the remarkable catalytic properties of iron and steel and of certain iron salts for some reactions that have been carried out in liquid ammonia. It seems possible then that the explosions in question have been brought about by the catalytic action of the metal containers. If any workers with liquid ammonia have in the past noted any explosive reactions between metallic mercury and liquid or gaseous ammonia wherein the reacting materials have been enclosed entirely in glass, the author feels that many workers would welcome the publication of such information.

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#### A TECHNIQUE FOR THE ELECTRON MICROSCOPIC EXAMINATION OF ENCAPSULATED BACTERIA

A STUDY of encapsulated bacteria is being carried on at the Institute of Paper Chemistry as part of an investigation of the causes for and the control of slime in paper mills.

The bacterial cells were seen, but neither the capsules nor the outlines of the capsules were visible when the specimens were prepared for the electron microscope by the ordinary technique of placing a drop of the bacterial suspension on the collodion film-covered specimen screen and drying. This failure to observe the capsules in the electron microscope is entirely analogous to the difficulty experienced in light microscopy when attempts are made to observe capsular ma-

terial without the use of special and difficult staining procedures or without Gins India ink smear technique. In view of our failure to prepare satisfactory specimens for the electron microscope by the usual technique, the use of a method similar to Gins was clearly indicated. The following procedure was found convenient and satisfactory:

India ink is diluted with about an equal volume of distilled water and a drop of the diluted ink placed on a slide and mixed with a drop of the bacterial suspension. Smears are made as in Gins method. Without fixing and staining the smear, a few drops of a 2 per cent. solution of collodion in amyl acetate are placed on the slide outside of the area covered by the smear and the slide is tilted and turned to allow the collodion solution to run over the smear. The excess solution is removed by a blotter on which the end or corner of the slide rests and the thin film on the slide is allowed to dry. Immediately thereafter, the slide is gently lowered, film side up and with its length forming a 45-degree angle with the water surface, into a dish of distilled water. The collodion film separates from the glass and, carrying the smear with it, floats on the surface of the water. The specimen screens are then placed on the film and handled in the usual fashion for preparing specimens to be examined in the electron microscope.

The specimens prepared for the electron microscope in this way clearly show the outline of the capsules surrounding the bacterial cells.

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<sup>4</sup> T. Ewan, *Br. Pat.* 222,718.

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<sup>6</sup> J. Nieuwland, *U. S. Pat.* 2,202,994.

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## THE DYCHE MUSEUM AT THE UNIVERSITY OF KANSAS<sup>1</sup>

By Dr. ALEXANDER WETMORE

ASSISTANT SECRETARY, SMITHSONIAN INSTITUTION

SOME years ago I found myself a graduate from Montgomery County High School in Independence, Kansas. The study of birds was a paramount interest with me and I had aspirations for college. Iowa, California, other places, offered inducements, until a friend loaned me a catalogue of the University of Kansas and I learned of the University Museum, now the Dyche Museum. Among other descriptive details I read of a collection of Central American birds. Foreign birds at the time were unknown to me, except for a few that I had seen in circus menageries or

stuffed in the parlors of friends, and were an irresistible attraction. I decided at once that the courses in biology offered at K. U. were the ultimate of my desire, and in September several days before the fall term opened I was in Lawrence. My first visit to the "Hill" led me to the cool great hall of this museum, and in this building it was my fortune to spend much of my time during my undergraduate years.

The foreign birds, I may add, proved to be the Gaumer collection from Yucatán, given by an alumnus who had worked with Snow and with Dyche, and who later had settled in Mexico. No one had studied these specimens, so that I had the keen delight of identifying and labeling many of them—and since I have known most of them in their native haunts in life.

<sup>1</sup> Address given at the reopening of the Dyche Museum during ceremonies on the occasion of the seventy-fifth anniversary of the founding of the University of Kansas, June 6, 1941.

I go back in my mind on this occasion beyond L. L. Dyche, for whom this museum is named, to Francis Huntington Snow and his work as the pioneer in natural science in Kansas so far as this university is concerned.

Early expeditionary parties sent out by the government to survey the West often crossed through Kansas, and their naturalists made many observations that have much value to workers of to-day. But it is to Snow that we owe the foundation of these studies on behalf of our alma mater. The story of his work has been told most sympathetically and understandingly by Dean Stouffer in a recent number of the *Graduate Magazine*, and the value of his teachings has been demonstrated by the accomplishment of his many students. As a freshman I came too late to have the privilege of attendance in his classes, but profited by his friendship in the later years of his life when he had retired from his administrative duties but was still occupied to the exclusion of other interests with the collections of insects that he had assembled.

As one more story of Dr. Snow's industry, in addition to those told by Dean Stouffer, may I relate the following. I returned to the university one year in midsummer with a collection of skins of birds that I had secured in northern Arizona. Work in the laboratories began for me at eight in the morning, but through rising at six I could reach the museum by seven and so have an hour for research on my specimens. But any feeling of personal vanity at this display of energy was humbled in me completely by the fact that each day as I came toward the building I met Dr. Snow coming down the hill on his way to breakfast after having spent two hours or more at work in the early morning. And often late in evening I saw lights in the windows of his study. That I knew Francis Huntington Snow has been one of my treasured memories.

Lewis Lindsay Dyche was one of Dr. Snow's students who remained at the university, first as an assistant and later as a member of the professorial staff. Dyche was interested especially in field work and the collecting of specimens, and for his period was a notable traveler. New Mexico, northern Minnesota, California, Greenland and southeastern Alaska, among many other places, were known to him, and from his travels in what were then wild places he returned to the university with skins and skulls and skeletons of deer, caribou, walrus, seals, polar bears, mountain sheep, goats, smaller mammals and birds, many of which were mounted in life-like attitude and which to-day form the nucleus of the groups shown in our renovated museum.

For years Professor Dyche traveled through Kansas to tell in high schools and other halls the story

of his adventures illustrated with stereopticon pictures of the places that he had seen. Undoubtedly it is these lectures that made him one of the best-known members of the university faculty of his day throughout the state, and that helped to persuade reluctant legislators of the desirability of a special museum building to house the collections that he and others had made.

The World Columbian Exposition held at Chicago in 1893 gave Professor Dyche definite opportunity, and there he received great acclaim for his panorama display of mounted mammals in a semblance of their natural habitat. It was this idea of a panorama exhibition that controlled the early installation of the displays in the Dyche Museum when it was finally completed. Little did I imagine when as a very small boy I marveled at Professor Dyche's specimens at the Fair in Chicago that I should later have some hand in their arrangement and care in the museum of this university.

The other collections housed in this building, in which Dyche had no hand, and often little interest, have equal importance in the attraction that the University Museum has for the constant procession of students with their families and their friends that come to its doors. The fossils, great and small, of the paleontological display, gathered under Williston, McClung and Lane, with Handel T. Martin as their early preparator and guardian, with their story of the past have awed and attracted thousands who have carried away from their visits impressions impossible to have been gained in other fashion. The many birds, mammals and reptiles are a constant source of study, and other creatures have come in for attention. The collections housed here are notable for an institution of this kind.

When in the history of mankind museums began is a matter concerning which we have no definite information. Man as a thinking animal is naturally curious about his surroundings and also acquisitive in gathering those concrete things that are attractive to him. Primitive man's first museum specimens no doubt were unusual objects that excited his interest, that he carried with him to his cave or shelter for further examination, or perhaps to prove to his wife and friends that his story about them was really so. Such interests must go far back in the history of the human race. In the United States National Museum in Washington we have on exhibition a replica of the two European bison modeled in clay by Pleistocene man in the cave of Tuc d'Audobert in southern France. Archeologists regard these as primitive magic concerned with the increase and abundance of the herds of wild game. This may well be, but to me as I stand before this case the figures represent the museum

exhibits of Aurignacian man of twenty thousand years ago. The horses, bison and birds drawn by early man of the same period on the walls of caves in the mountains of Spain must also represent early exhibitions of human art. That they have been preserved to the present day is one of the miracles of chance for which we must be forever grateful.

Aristotle, the father of modern natural history, was befriended by his pupil Alexander the Great, who assigned a considerable force of men to secure for him oddities in birds and beasts. It is related also that Ptolemy the first, in the famous library at Alexandria in Egypt, had what was in effect a museum and a university in combination, though we have little record of what was in it except for reference to manuscripts. More recently, in a palace at Ur dating about 3000 B.C., there has been found a labeled series of objects of archeological interest that evidently constituted a museum collection. We are told too that fossils and other curios were kept in some of the temples of the Greeks during the thousand-year period before the Christian era. These illustrate something of the little that we know of the beginnings of museums and are sufficient to indicate the definite antiquity of man's museum interest.

The oldest of existing museums had their foundations in the voyages of exploration of the fifteenth century. Columbus was charged by Queen Isabella to collect strange birds, and it is recorded that he took back to Spain from his voyages the skins of various beasts. We are told that in his triumphal parade in Barcelona, in April, 1493, there were displayed live parrots and the skins of birds. Men of wealth of this period of extensive exploration in new lands began to maintain collections of various kinds, and interest in natural history as a science became wide-spread. Such a collection was that of Sir Hans Sloane which, in 1753, became the foundation of the British Museum of Natural History, one of the great institutions of its kind in the world.

In the early days of the historical period in the New World our own country was the source of much natural history material that went abroad, but museum interest came early among the colonists of what is now the eastern part of the United States. Without going into too much detail, there is record in the year 1750 of a "Repository of Curiosity" at Harvard College, which included "horns and bones, fishes, skins and other objects." This was destroyed by fire in 1764, but in 1769 a room was set aside in the college for a "Museum." Thus began the present-day Museum of Comparative Zoology, of Harvard College. Among other existing institutions the museum in Charleston, South Carolina, was founded in 1773, and that of the Academy of Natural Sciences in Philadelphia in 1812.

That there are to-day throughout the world more than 7,000 museums of which more than 1,000 are in the United States is a fact in itself significant in establishing the worth and value of the museum as a cultural feature of our modern life. Also significant is the fact that approximately 25,000,000 persons visit our American museums each year.

In considering American museums and their present place in our lives it is pertinent to say something about our National Museum in Washington, since it is this organization that has been a constant example in the development of museum projects with a more local field.

The Smithsonian Institution had its beginning in a bequest of money from James Smithson, an Englishman, who died in Genoa in the year 1829. In his will Smithson left his estate to the United States of America to found at Washington, under the name of the Smithsonian Institution, an "establishment for the increase and diffusion of knowledge among men."

In the minds of many there is some confusion with regard to the relation between the Smithsonian Institution and the United States National Museum. The two are distinct, though many consider them as identical. In brief, the Smithsonian is a privately endowed organization that in the course of its history has developed, at the expense of its own funds, various activities that have been publicly accepted as important so that as they grew beyond Smithsonian means they have been supported by governmental appropriations. As examples of these I may mention the National Museum, the Astrophysical Observatory, the National Zoological Park and the Bureau of American Ethnology. The National Museum then is a bureau or branch supported by the government, under the administration of the Smithsonian Institution, which still contributes largely to museum researches and adds to its specimens through the income from its endowments. In fact, the Smithsonian administers various funds that have been given entirely for the support of collections in the museum.

The act of foundation of the Smithsonian provided that it should include a museum for objects of natural history, plants and geological, mineralogical and other specimens belonging to the Government. Under this provision there came to it immediately the collections made by the Wilkes Exploring Expedition, which under an appropriation of one million dollars was engaged from 1838 to 1842 in an exploratory journey around the world.

From small beginnings the United States National Museum has grown until it is one of the greatest that exists. Its collections now comprise more than 17,000,000 catalogue entries, and are valued at more than \$150,000,000. This appraisal is made with the

statement that with ten times that sum of money available the collection could not be duplicated, because of the many unique things that it contains.

From the vast collections of this museum's five departments many specimens are arranged for exhibition in the public halls. That this forms an attractive feature to those who come to our capitol city is indicated by the figures of the last fiscal year when our visitors included more than two million five hundred thousand persons. On public view there are found such objects of patriotic interest as the original flag that, flying over Fort McHenry, inspired Francis Scott Key to write "The Star Spangled Banner," the sword and other relics of General Washington and similar articles from scores of other persons famous in American history. Airplanes, engines, early types of horse-drawn vehicles and ancient automobiles, and scores of important patent models attract hundreds to the engineering exhibits. Skeletons of huge dinosaurs and other animals of the past, groups of mounted animals collected in Africa by Theodore Roosevelt, birds, reptiles, life-size models of Indians and other peoples in their appropriate dress fill the halls of the Natural History Building.

But in addition to these public displays there are even more valuable study collections, arranged properly for reference in the museum laboratories, that are in constant use for scientific studies of many kinds. A short time ago some one asked if any single person had seen all the objects in our great collections. My answer was that the life-time of an individual would not be long enough, as such an inspection carried on at the rate of a reasonable number of specimens per hour for eight hours a day would require more than one hundred years.

I have just indicated that our National Museum in Washington is a national asset in its educational contacts with the entire world, through its exhibition halls open to visitors, through its publications that make available everywhere the results of researches on its vast collections and through the reference collections that are used not only by our own staff but also by the many accredited investigators who come to Washington to study. This university museum that we have come to formally open to-day, equally valuable in proportion to its size, differs in that its field is more directly educational through its definite contact with students. Such a museum with proper support both in finances and interest becomes one of the important factors in the scheme of education of its institution. We are fortunate that Kansas has recognized that fact, one well-known to our present chancellor through his own acquaintance as an undergraduate with our museum halls.

Let me add here that while museums will be developed and expanded so long as our civilization con-

tinues the earlier in their history they receive adequate support the more effective they will become. This is true not only because of the greater facilities that this may afford at the current time but also because in most branches of museum interest many of the most desirable materials become each year more difficult to obtain.

Civilized man is steadily occupying increasing areas of the surface of the earth, and with his occupation come such vast changes from the original condition that natural conformations are destroyed, and hundreds of thousands of individuals of animals and plants and hundreds and thousands of species must disappear. Only those can remain that are sufficiently adaptable to fit into the modified scheme brought by man's presence. Those at all sensitive to change or that require special conditions for their existence inevitably disappear. The next fifty years will offer the last opportunities to secure many forms of nature for preservation for the future. This does not mean that present timely interest in conservation is not worthy of the attention that it receives. I wish merely to indicate that many things of museum interest must be acquired now, as in later years they may be extinct, or may be found only in reserves in such small numbers that none may be taken for museum use lest the entire stock be weakened until it is destroyed. Yearly, therefore, it becomes more and more important, in fact, a duty, to secure such material for the information and study of future generations, while it may be obtained without pressure on the species concerned. Opportunities now neglected may never offer again.

Our own life-time as individuals indicates the meaning of what has just been said. The spread of population here in Kansas is an excellent illustration, since agriculture here has expanded to the exclusion of vast numbers of wild things that formerly ranged within our borders. That all this is right and proper no one will deny, but the effect on much of the wild life of the surrounding region will remain.

We see in the newly opened halls of the Dyche Museum attractive exhibits of many kinds, of mammals, birds, fossils and other objects where the subjects are presented in interesting and often in lifelike manner. The new installations are fascinating and valuable, and we may return to them time after time with friends and relatives or alone to enjoy them and to profit from them to the utmost.

But let me impress upon you the very pertinent fact that these displays, attractive though they may be, are not the most important properties of this museum. The exhibitions once installed may be renovated periodically, but such changes come only at long intervals. While definitely important as educational factors they are in a sense static.

Behind the scenes in this museum, as in the National

Museum in Washington, are rows of cases of study specimens of skins and skeletons of birds and mammals, specimens of reptiles and amphibians, and many other creatures, which are used for the training and study of advanced students and are seen only by such visitors who have special interest in them. These collections, augmented greatly from their early beginnings by the work of Lane, Bunker, Taylor, Hibbard and their assistants, to name only those now here, are known to scientific investigators everywhere. They form a portion of the valuable properties of our university, and constitute in considerable part the dynamic force of this museum. From the investigations concerned in their gathering and study there has come the enthusiasm that has trained dozens of workers in biology who have gone out from the university to make good names in their chosen fields in museums and laboratories throughout this country.

Those who remain in Lawrence may have difficulty in attaining perspective on this point, but to illustrate my meaning it is necessary only to think of the graduates from this university now working in biological or related fields in institutions throughout the United States. Their number and the importance of their work has been constantly evident to me in recent years as administrative duties have claimed more and more of my attention. Their training began here in this museum, and without that early opportunity and inspiration they could not have attained their present status and experience.

Instruction in biology necessarily covers the broader aspects of the subject particularly in the beginning courses, and research in university laboratories on the part of the professors and graduate students, centers often on investigations where there may be developed laws or summations common to large groups of species or to life as a whole. In the enthusiasm that attends this type of investigation we must not forget, however, that in the end we are dealing with species, whether of plants or animals, and that it is a matter of prime importance to us to know the name or names of the groups with which we deal. As our information in physiology, general anatomy and psychology of species other than man increases we find surprising differences in reaction between forms that appear so closely similar superficially, that it may be difficult to those not expert to distinguish them. It is obviously necessary to know the proper identity of these if one is to interpret correctly observations of any kind made upon them. The ecologist is entirely dependent on the proper identification of material for his investigations of animal and plant forms, and studies of individual variation or of chromosomes or of those things included in the science of genetics, whether in kinds of mice or insects, obviously may be misleading if the

material used includes two or more closely related forms that hybridize freely, unless this hybridization is known and understood.

In training in such identifications the University Museum stands in the same relation as the library. The museum laboratories with their study collections are therefore of prime importance in all biological work, not alone in their training of workers who may go out into museums but in the facilities that they offer for basic identifications. The laboratory collections, therefore, that to the uninitiated may appear unattractive, are, nevertheless, a truly dynamic part of the organization. They are the inspiration that leads to understanding of the infinite variety of species that make up our world of living things. Their worth increases as they themselves grow and increase. Let me repeat that, while the exhibition halls of this museum are attractive and instructive, behind the scenes in the laboratory collections there is found a most valuable function and one that continues year after year with steadily growing importance.

During my days as a student in this building we realized that its construction was such that extensive changes would some day be necessary, and finally some years ago it was required that the collections be removed to storage until repairs could be completed. Thanks to the interest of those charged with appropriations this work was made possible, and now finally the great work of installation has been completed. The success of this is evident to all and needs only our admiration. Our thanks must go to those who have done this work so skilfully and so well.

The halls of the Dyche Museum now are open again, but though closed to the public for a period the work that the institution typifies has continued steadily, quietly and unostentatiously behind the scenes. Its training and its opportunities in the kind of science that it concerns have never ceased, though its exhibitions were stored and inaccessible. The spirit of the organization has continued without break.

That the present day is one of difficulty is a fact continually in the minds of all of us. The conflict abroad is now nearer to us than ever before and steadily our own responsibility both individually and as a nation increases. A few days ago a friend in England sent me a bit of shrapnel with the laconic statement that it had fallen on his house the night before. I know this house in the heart of residential London well, and to hold this bit of metal in my hand has brought the terrible conflict now raging over that great city to me with a clarity that no press accounts of the destruction wrought by German bombs can ever equal. Our nation is expending huge sums of money for armament to guard that such terrors may not come

to us here. These entirely necessary expenses mean increased taxes and financial troubles for all, a condition that may continue throughout the rest of our lives.

Support of this great defense program is paramount and essential, but with it let us not forget that in cultural and esthetic pursuits there are not only improvement for the mind and training for the future, but also momentary escape for the individual from the troubles that beset him. In the halls of our museums, our art galleries and our libraries through-

out our great nation there is found enjoyment and recreation for the public to be encountered nowhere else. The contemplation of nature and its laws, and of the individual objects that exemplify these, brings a relief and a peace not elsewhere possible. Public morale, of maximum importance under the grim threats of war, is fostered by such mental relaxation. These are facts to be remembered in periods of stress, that the small financial support for such activities be not denied. Let us consider this as a contribution to the defense armament of the mind and of the soul.

## SOME UNSOLVED PROBLEMS OF THEORETICAL DYNAMICS<sup>1</sup>

By Dr. GEORGE D. BIRKHOFF

PERKINS PROFESSOR OF MATHEMATICS AT HARVARD UNIVERSITY

As was first realized about fifty years ago by the great French mathematician, Henri Poincaré, the study of dynamical systems (such as the solar system) leads directly to extraordinarily diverse and important mathematical problems in point-set theory, topology and the theory of functions of real variables.

On the other hand, the abstract point of view emphasized by the foremost American mathematician of the same period, E. H. Moore of the University of Chicago, led him in the early years of the present century to his "general analysis." Moore sought to introduce an absolutely general independent variable, ranging over an abstract space, whereas previously attention had been limited to an independent variable ranging over ordinary  $n$ -dimensional space. He hoped that in this way the abstract essence of various current theories in analysis might be more clearly revealed. Ideas of a somewhat similar type had been proposed a little earlier by Maurice Fréchet and also by Erhard Schmidt. But only Moore saw the full significance of general analysis for mathematical thought; and it is only in recent years that his ideas are receiving the attention which they deserve from mathematicians.

An early illustration of the wide scope of these Moorean ideas was furnished by the "recurrent motions" of dynamical systems first defined and studied by the writer in 1910, shortly after the completion of his graduate studies at Chicago. The possibility of making an extension of this theory so as to define "recurrent motions" and certain analogous "central motions" in the sense of general analysis was announced by him in his Chicago Colloquium Lectures on Dynamical Systems in 1920.

The principal part of his paper was occupied with

this abstract phase of dynamics, which has been the subject of much recent work by American mathematicians and by the powerful contemporary Russian mathematical group. The kind of abstract space,  $R$ , which it seems best to employ is a compact, metric space. Corresponding to the change in "time"  $t$  there is a steady flow of the space  $R$  into itself, each point tracing out a "curve of motion" in  $R$ . The individual points represent "states of motion," and each curve of motion represents a complete motion of the abstract dynamical system. Thus there is provided not only an abstract space  $R$  but a "continuous group":  $G: t' = t + c$ . In other cases this group may be discrete:  $t' = t + n$  ( $n$ , an integer), or of still more complicated form. For a continuous flow in such an abstract space  $R$ , the recurrent motions are merely those which trace out with uniform closeness in *any* sufficiently large period of their entire history, all their states; a periodic motion, represented by a closed streamline, affords the simplest illustration of such a recurrent motion. The analogous central motions are those which recur infinitely often near to any particular state of the motion, or at least have such motions in the infinitesimal vicinity of any state.

The first ten of the sixteen problems presented and briefly discussed were of this abstract type.

Problem 1 embodied a conjecture as to the inter-relationship between continuous and discrete flows in such an abstract space  $R$ . It is easy to see that this relationship must be an intimate one by recalling the close connection between an ordinary changing visual image of continuous type and the corresponding moving-picture image of discrete type. In the abstract space  $R$  a species of reduction of a continuous flow to a discrete flow or at least one of "extensibly discrete" type may be effected by a process of sectioning,

<sup>1</sup> Summary of a paper presented at a fiftieth anniversary symposium of the University of Chicago, September 24, 1941.

first employed by Whitney in a local manner. It was conjectured that conversely any such extensively discrete flow may be imbedded in an ordinary continuous flow. Ambrose and Kakutani have recently obtained interesting results lying in the same general direction as this first problem.

In problems 2 and 3 it was conjectured that *all* the motions of a continuous flow will be recurrent if and only if the flow may be decomposed into a set of irreducible constituent flows which are "homogeneous" (i.e., such that the stream lines are topologically indistinguishable from one another). Thus the familiar two-body problem for a sufficiently small value of the energy constant is of this type, the irreducible constituents being the individual periodic elliptic motions.

The flows which arise from ordinary dynamical problems are not only continuous but in general are "conservative," i.e., leave a volume integral invariant, as in the case of the flow of an incompressible fluid. This property of conservativeness was used about seventy-five years ago by Boltzmann and Maxwell in the foundation of statistical mechanics. It is easy and natural to extend the definition of conservative flows to the abstract case. Important studies of abstract conservative flows have been made recently by Beboutoff, Bogoliuboff, Kryloff, Stepanoff in Russia and by Halmos, Oxtoby, Ulam, von Neumann, Wiener and Wintner in this country, among others. The field of mathematics devoted to the study of conservative flows has risen to the rank of an important branch of mathematics, called "ergodic theory." This theory is destined to play a fundamental role in statistical mechanics, although as yet its importance for this field has not been generally realized by physicists.

Problem 4 was concerned with such conservative abstract flows. Here the interesting conjecture was advanced that at least if the abstract flow is so regular as to be "geodesic," then it will be conservative if all the motions are central. The converse fact was essentially established by Poincaré in the third volume of his "Méthodes Nouvelles de la Mécanique Céleste."

The reasonableness of this conjecture was based upon the use of a modified type of "compressibility volume" of the kind introduced by E. Hopf, and an analysis of recent remarkable results of Denjoy which established the unexpected fact in a simple special case that the *ultimate* behavior of a dynamical system may depend on the degree of regularity of the functions which characterize it.

In problem 5 it was likewise conjectured that the recurrent motions are necessarily everywhere densely distributed in the space  $R$  of a conservative flow. Poincaré has made an analogous but stronger conjecture in the case of the restricted problem of three bodies and of certain analogous problems when  $R$  is

a three-dimensional space, namely, that the periodic motions are everywhere dense in the totality of motions, but it is known that his conjecture does not always hold. Questions of this general type are of philosophical interest, since the crude speculation that all dynamical systems are periodic or nearly so presents itself irresistibly to the human mind.

It was emphasized that from another point of view the real significance of the conservativeness of a flow is that (almost) all motions have *habitual modes of behavior in the mean with respect to any measurable process*. For example, consider the idealized frictionless motion of a billiard ball on a billiard table which has the shape of a convex oval. In any such motion the ball will be in the long run a definite proportion of the time on any assigned part of the table, will collide with the rim at a certain definite angular rate, etc. Problem 6 proposed a topological characterization of conservative flows based on this fact, similar to that given by Oxtoby and Ulam, in an as yet unpublished paper.

In problem 7 the restriction of continuity upon a conservative flow was relaxed, and a characterization of the invariants of the flow based on certain "packing coefficients" was proposed. A characterization of certain special types of such flows in terms of their "spectra" has been recently obtained by Halmos, von Neumann, Wiener and Wintner.

Up to this point continuous steady flows in  $R$  and the more special "conservative" type had alone been considered. But the continuity and conservativeness combined do not suffice to characterize the flow of true dynamical type except in the simplest case of two dimensions ( $n=2$ ). Hence it is of especial importance to define abstractly a "dynamical" flow. This was attempted by the writer. Roughly speaking, he takes Pfaffian systems as the model for his abstract definition rather than the more familiar but equivalent Hamiltonian systems of classical dynamics. In this way his task becomes that of formulating an abstract equivalent for the variational condition,

$$\delta \int \sum X_i dx_i = 0.$$

The crucial part of his characterization of a dynamical flow lay in the suitable definition of a line integral in any abstract "geodesic space"  $R$ . One conspicuous advantage of such a characterization of a dynamical flow is that the flow in any invariant subspace of  $R$  is seen at once to be of dynamical type also.

It should be emphasized that hitherto the question of the adequate characterization of a dynamical flow beyond the obvious facts of continuity and conservativeness has been especially baffling. The proposed analytic characterization and the conjectured qualitative characterization embodied in problems 8, 9 and 10 should prove suggestive in this connection. In

problem 8 it was asserted that a dynamical flow is necessarily conservative; in problems 9 and 10 that, certain cases aside, not only are the periodic motions everywhere dense but *the stable periodic motions are everywhere dense and dense on themselves*. Here a stable periodic motion was defined purely topologically as any periodic motion in whose infinitesimal vicinity lie other complete motions. A partial converse is known to hold through results obtained by D. C. Lewis and the lecturer.

Problem 11 was of a nature intermediate between the case of an abstract space  $R$  and a space  $R_n$  of  $n$  dimensions, and was the only problem not stated in complete form. It called for the appropriate generalization to a gas of certain remarkable results for the famous three-body problem due to Sundman, and extended by the writer and Hinrichsen to  $n > 3$  bodies and to a more general law of force than that of Newton.

Problem 12 called for an example to show that in the case of a continuous (non-conservative) flow in a space  $R_n$  of  $n \geq 3$  dimensions, the ordinal series of "wandering motions" leading to the central motions need not always terminate in  $n$  or fewer steps.

In problem 13 it was conjectured that essentially the only 3-dimensional discrete flows which are "regular" in the sense of Kerékjártó are (1) combined rotations of three circles into themselves; (2) combined rotations of circle and surface of a 3-sphere into themselves; (3) rigid rotation of a 3-dimensional hypersphere into itself.

Problems 14 and 15 were closely related. The first of these asserts that a 1-1 direct analytic area-preserving deformation of the surface of a sphere into itself which has two fixpoints, and is such that iterates of the transformation have no other fixpoints, is a pure rotation from a topological point of view. Considerable evidence was adduced for this conjecture. The second problem embodied an analogous conjecture concerning a plane circular ring.

The last two of the announced problems (problems 16, 17) will perhaps excite the most interest, since

they embody conjectures which in a certain sense yield a kind of complement to the famous "last geometric theorem" of Poincaré, announced as probably true by Poincaré shortly before his death and established subsequently by the lecturer. Suppose that there be given a ring-shaped part of the plane bounded by two concentric circles. Suppose that this ring is deformed into itself in any way so that the areas of small figures are conserved, while the points on the two circles are advanced by angular distances  $\alpha$  and  $\beta$ . If  $\alpha$  and  $\beta$  are distinct, Poincaré's theorem leads at once to the conclusion that there are infinitely many periodic sets of points under the indefinite repetition of this deformation. But if  $\alpha$  and  $\beta$  are equal, his theorem is not applicable. The conjecture was made that the same result (as well as other more specific ones) will hold in the case  $\alpha = \beta$ , provided that some nearby points of the ring become separated widely in an angular sense by sufficient repetition of the deformation, as clearly happens when  $\alpha$  and  $\beta$  are unequal. This conjecture was proved in the very important special case when the given conservative deformation can be expressed as the product of two involutonic deformations.

In consequence, for the classic restricted problem of three bodies treated by the American astronomer G. W. Hill, so long as there exists a "surface of section," either there exist infinitely many periodic motions (for a given value of the "constant of Jacobi") or all possible motions of the "infinitesimal body" (the Moon in the Earth, Moon, Sun case) will necessarily have the same mean rate of synodical advance of perigee about the near-by finite body (the Earth), per synodical revolution. It was also pointed out how the absence of infinitely many periodic orbits would indicate that a new *qualitative* integral exists, in addition to the usual analytic integral of Jacobi.

The problems presented and discussed by the writer will be likely to receive attentive consideration from other mathematicians inasmuch as they embody challenging conjectures concerning important open questions in the actively advancing field of theoretical dynamics.

## OBITUARY

### ELMER SAMUEL IMES

IN the death of Elmer Samuel Imes science loses a valuable physicist, an inspiring personality and a man cultured in many fields.

Professor Imes was born on October 12, 1883, in Memphis, Tennessee, the son of Home Missionary parents. His father, Benjamin A. Imes, a graduate of Oberlin College and Theological Seminary, was among the pioneers in educational and church work

in the southern field of the American Missionary Association.

Imes taught for many years in the American Missionary schools, principally in Albany Normal School, Albany, Georgia, before he pursued his ultimate and highest interest, the field of physics and its educational and commercial adaptations.

He was graduated from Fisk University in 1903, and did graduate study both there and in the Uni-

versity of Michigan, from which institution he received his Ph.D. degree, his thesis having to do with infra-red spectra, a subject on which he has acquired an international reputation. Prior and subsequent to receiving his degree he was a research and consulting engineer and physicist. For ten years, ending on his death on September 11, 1941, he was professor of physics and head of the department of physics at Fisk University, Nashville, Tennessee, where he created a highly efficient organization.

He leaves a mother, Mrs. Elizabeth W. Imes, and two brothers, Albert L. Imes, of Cincinnati, Ohio, and the Reverend William Lloyd Imes, pastor of St. James Presbyterian Church, New York City.

It was the writer's privilege to become acquainted with Professor Imes in his graduate student days at the University of Michigan, where his research laboratory was a mecca for those who sought an atmosphere of calm and contentment. Peacefully smoking his pipe, Imes could always be relied upon to bring to any discussion an atmosphere of philosophic soundness and levelheaded practicalness. Gifted, moreover, with a poetic disposition, he was widely read in literature, and a discriminating and ardent appreciator of music. He had a delightful sense of humor and a skill in repartee, which he always used, however, with the kindness and consideration so characteristic of his sensitive nature. In his passing, his many friends mourn the loss of a distinguished scholar and a fine gentleman.

W. F. G. SWANN

BARTOL RESEARCH FOUNDATION  
OF THE FRANKLIN INSTITUTE,  
SWARTHMORE, PA.

#### MAX KRISS 1894-1941

PENNSYLVANIA STATE COLLEGE lost one of its leading scientists as Dr. Max Kriss died from coronary embolism on November 16 after an illness of two weeks.

During twenty-three years as a member of the staff of the Institute of Animal Nutrition, Dr. Kriss became one of the world's leading authorities on the energy metabolism and ventilation requirements of domestic animals, the net energy values of feeding stuffs and the influence of nutrient compounds, especially amino acids, on the heat production of animals.

Born on May 16, 1894, at Ostropol, Russia, the son of Joseph Kriss, a scribe, and his wife Fannie, Max Kriss came to the United States in 1910. He earned his own way through Pennsylvania State College by labor and by teaching Russian and Hebrew. Being graduated in 1918, he became a member of the staff of the Institute of Animal Nutrition under the direc-

tion of Dr. Henry Prentiss Armsby, and at the time of his death held the rank of professor of animal nutrition.

At Pennsylvania State College, Kriss received the degree of master of science in 1920, and at Yale University the degree of doctor of philosophy in 1936.

He was the author or co-author of more than 50 scientific papers dealing with animal nutrition. Always a modest, kindly and charitable gentleman he gave great pleasure to his associates during discussions of scientific problems because of his fair and scholarly disposition.

He leaves a wife and one son, Joseph, who is a student at Yale University School of Medicine.

E. B. FORBES

PENNSYLVANIA STATE COLLEGE

#### DEATHS AND MEMORIALS

DR. ELSIE CLEWS PARSONS, president of the American Anthropological Association, died on December 19. She was sixty-six years old.

PROFESSOR ROLLIN LANDIS CHARLES, head of the department of physics at Franklin and Marshall College since 1922, died on December 13 at the age of fifty-six years.

DR. PAUL HENRY HANUS, professor emeritus of education at Harvard University, died on December 14 at the age of eighty-six years. An important advance was made in 1891 when Dr. Hanus was appointed assistant professor of education at Harvard University through the influence of President Eliot.

DR. FRANK CONRAD, assistant chief engineer of the Westinghouse Electric and Manufacturing Company of Pittsburgh, died on December 11 at the age of sixty-seven years.

DR. VLADIMIR J. FEWKES, archeologist, research associate of the museum of the University of Pennsylvania, died on December 11 in his forty-sixth year.

A BUST of the late Dr. William H. Nichols, donor of the Nichols Chemistry Building of New York University, acting chancellor of the university in 1929, was unveiled at an informal ceremony in the Nichols Building on December 19. The bust was given to the university by Mrs. Madeline Sharp, daughter of Dr. Nichols, and was accepted by Dr. John P. Simmons, director of the Nichols Laboratory. Other speakers were Dr. Harry Lindwall, chairman of the department of chemistry of the University College of Arts and Pure Science; Dr. Henry J. Masson, chairman of the department of chemical engineering of the College of Engineering, and Dean Thorndike Saville, of the College of Engineering.

## SCIENTIFIC EVENTS

### THE ADVISORY BOARD ON SANITARY AND PUBLIC HEALTH ENGINEERING

MEMBERS of the National Technological Civil Protection Committee, appointed by the Secretary of War in January, 1941, have agreed to act also as an Advisory Board on Sanitary and Public Health Engineering to the Medical Division of the Office of Civilian Defense. The committee, which represents the major engineering and related societies, includes:

Walter D. Binger, New York, American Society of Civil Engineers, *chairman*.

W. H. Carrier, Syracuse, N. Y., American Society of Heating and Ventilating Engineers.

Frederick G. Frost, New York, American Institute of Architects.

E. M. Hastings, Richmond, Virginia, American Railway Engineering Association.

Harry E. Jordan, New York, American Water Works Association.

W. Cullen Morris, New York, American Gas Association.

John C. Parker, New York, American Institute of Electrical Engineers.

Arthur B. Ray, New York, American Institute of Chemical Engineers.

Scott Turner, New York, American Institute of Mining and Metallurgical Engineers.

James L. Walsh, New York, American Society of Mechanical Engineers.

Abel Wolman, Baltimore, American Public Health Association.

The Office of Civilian Defense will have a contact member on this committee, as does the War Department. Ralph E. Tarbett, senior sanitary engineer, U. S. Public Health Service, who has been assigned as chief sanitary engineer of the Medical Division of the Office of Civilian Defense with headquarters in the Washington office, will be the contact member.

Regional sanitary engineers are being appointed by the Medical Division of the Office of Civilian Defense to work through state defense councils with state health departments in planning defense against belligerent action. Most important of their immediate duties will be to promote development of protective measures for public water supplies, which may be subject to destructive enemy action. The engineers will also consult with health authorities on such matters as emergency maintenance of sewerage, sanitary facilities, garbage disposal, protection of food and milk supplies in the event of a disaster.

Two regional sanitary engineers are already on duty. Gordon E. McCallum, sanitary engineer, U. S. Public Health Service, has been commissioned in the

Public Health Service Reserve and assigned to the Third Civilian Defense Region (Pennsylvania, Maryland, District of Columbia and Virginia) plus West Virginia and Ohio. Mr. McCallum is stationed in Washington. John H. Brewster, at various times sanitary engineer for the American Waterworks and Electric Company and for the New York and Indiana state health departments and recently a private consultant in Troy, New York, has also been appointed a sanitary engineer in the Reserve of the Public Health Service and assigned to the First and Second Regions (New York, New Jersey, Delaware and the New England states).

### RESEARCH GRANTS OF THE VIRGINIA ACADEMY OF SCIENCE

DR. FRANK A. GELDARD, professor of psychology at the University of Virginia and chairman of the Virginia Academy of Science Research Committee, has announced that the following scientific workers in the state have been awarded research grants to aid them in their investigative work. The recipients are:

Margaret Altmann, of Hampton Institute, for a study of basal temperature curves of ten Negro women students during the sex cycle; Aaron Appleby, of the Virginia Polytechnic Institute, for his work in trying to find a calcium compound better suited than calcium gluconate for administering calcium ions to animals; Thomas A. S. Hayes, of the Virginia Polytechnic Institute, for a survey of the prevalence and importance of the large-mouth bowel worm in sheep in Virginia; H. W. Jackson, of the Virginia Polytechnic Institute, for the construction of an improved electrical machine for temporarily stunning fish, the determination of the exact composition of the fish population of a given area being often an important guide in the management of a pond; A. Margarite Bisle, of Randolph-Macon Woman's College, to help her in an investigation in astronomy; Robert W. Root, C. Lane Sarter, N. C. Steenland, Robert O. Wilbur and H. H. Woods, senior students at Washington and Lee University, for a detailed study of the geology of the area immediately around Lexington; Frances A. Schofield, of Randolph-Macon Woman's College, to complete a study having to do with biochemistry, and J. C. Strickland, of the University of Virginia, to help him to complete a collection of the blue-green algae of the state.

Members of the Academy Research Committee besides Dr. Geldard are Dr. F. C. Vilbrandt, of the Virginia Polytechnic Institute, and Dr. Gillie Larew, of Randolph-Macon Woman's College. Dr. Ivey F. Lewis, of the University of Virginia; Dr. Rolland J. Main, of the Medical College of Virginia, with the officers of the academy; Dr. George W. Jeffers, of Farmville State Teachers College; Dr. E. C. L. Miller

and Dr. Sidney S. Negus, of the Medical College of Virginia, are *ex-officio* members.

Dean Earle B. Norris, of the Virginia Polytechnic Institute, has been invited by the committee of the academy to make a study on its behalf of research needs and research facilities in Virginia with special reference to cooperation between science and industry.

### THE AMERICAN CHEMICAL SOCIETY

DR. PER K. FROLICH, director of the Chemical Division of the Esso Laboratories of the Standard Oil Development Company at Elizabeth, N. J., known for his work in the development of synthetic rubber, has been elected president of the American Chemical Society for 1943.

Dr. Frolich will take office as president-elect on January 1, when Dr. Harry N. Holmes, head of the department of chemistry at Oberlin College, becomes president, succeeding Professor William Lloyd Evans, head of the department of chemistry at the Ohio State University.

The election was made by the council from the four nominees receiving the largest number of votes in a mail ballot of the 29,000 members. The council includes national officers, directors, editors of the publications of the society, chairmen of eighteen professional divisions, councilors from the ninety-four local sections and councilors-at-large.

Professor Arthur J. Hill, of Yale University, and Dr. E. R. Weidlein, director of the Mellon Institute of Industrial Research, Pittsburgh, were chosen directors. Dr. Charles Allen Thomas, director of the Thomas and Hochwalt Laboratories, Dayton, Ohio, research division of the Monsanto Chemical Company, was named director-at-large.

New councilors-at-large are Dr. George D. Beal, assistant director of the Mellon Institute of Industrial Research; Dr. Gustav Egloff, director of research of Universal Oil Products Company, Chicago, Ill.; Professor Henry Gilman, of Iowa State College, and Professor Carl S. Marvel, of the University of Illinois.

The official statement reads:

In addition to his contributions to the development of synthetic rubber, Dr. Frolich is best known for his work on transformation and chemical utilization of hydrocarbons, high-pressure gas reactions, catalysis and applied colloid chemistry.

At the one hundredth national meeting of the American Chemical Society in Detroit on September 9, 1940, Dr. Frolich and his research associates presented the first technical report on the discovery of butyl rubber, made from petroleum. The new process climaxed ten years of co-operative efforts by the Standard Oil research, development and management units carried on entirely independently of any other synthetic rubber development either in this country or abroad.

Dr. Frolich was born in Christiansand, Norway, in 1899,

and was graduated from the Norwegian Institute of Technology in 1921. He received the degree of master of science from the Massachusetts Institute of Technology in 1923, and the degree of doctor of science from the same institution in 1925.

Dr. Frolich was assistant chemist at the Norway Institute of Technology from 1919 to 1921, instructor at Christiansand Business College from 1921 to 1922, and American-Scandinavian Foundation Fellow at the Massachusetts Institute of Technology during 1922-1923. Dr. Frolich served as assistant in the Massachusetts Institute of Technology Research Laboratory of Applied Chemistry from 1925 to 1927. He became assistant director of the laboratory in 1927 and was advanced to associate professor in 1929, the year he joined the staff of the Standard Oil Development Company.

Dr. Frolich is the author of many technical papers and has been granted numerous patents. He has long been active in the American Chemical Society, serving as chairman of the Division of Petroleum Chemistry, chairman of the North Jersey Section, councilor-at-large, and associate editor of *Chemical Reviews*. He was awarded the Grasselli Medal in 1930 for outstanding achievement in chemistry, particularly in the field of high pressure reaction of gases.

### THE MEETING OF MATHEMATICIANS AT LEHIGH UNIVERSITY

THE forty-eighth annual meeting of the American Mathematical Society will be held at Lehigh University, Bethlehem, Pa., from Monday to Wednesday, December 29-31, in conjunction with meetings of the Mathematical Association of America, the Association for Symbolic Logic and the National Council of Teachers of Mathematics.

The sessions of the society, all of which will be held in the Packard Laboratory, will begin on Monday at 2 P.M. and continue through Wednesday afternoon. The sessions of the Mathematical Association will be held on Thursday morning and afternoon. On Wednesday afternoon, the Association for Symbolic Logic will hold meetings, one of which will be a joint session with a section of the society. The National Council will meet on Wednesday and Thursday.

The board of trustees will meet at 6 P.M., on Monday, and the council at 8 P.M., on Tuesday.

A symposium on applied mathematics will be held on Tuesday afternoon. The program will consist of two addresses, "The Mathematical Theory of Traveling Waves," by Professor L. V. Bewley, and "Some New Methods of Solution of Two-Dimensional Problems in Elasticity" by Professor I. S. Sokolnikoff, and discussions by Professors Alan Hazeltine, Ernst Weber, D. L. Holl and J. L. Synge.

On Tuesday, at 4 P.M., tea for visiting mathematicians and guests will be served in Drown Hall by the ladies of the Department of Mathematics of Lehigh University.

The annual business meeting and election of officers will be held on Wednesday morning. At this time the award of the Frank Nelson Cole Prize in Theory of Numbers will be announced, and the recipient will give a brief talk on the paper for which the prize is awarded. Following this, Professor Oscar Zariski will give an address entitled "Normal Varieties and Birational Correspondences."

The joint dinner (informal) for the four organizations will be held at the Hotel Bethlehem on Wednesday, December 31, at 8 p.m., followed by a New Year's Eve party which will continue until midnight, and will include a number of musical and entertainment features suitable to the occasion.

There will be a luncheon for members of Pi Mu Epsilon on Thursday.

### THE DALLAS MEETING OF THE AMERICAN ASSOCIATION

THE American Association for the Advancement of Science and its Associated Societies meet next week at Dallas, Texas. A full preliminary announcement of the program by the permanent secretary, Dr. F. R. Moulton, will be found in the issues of SCIENCE for November 28 and December 5.

The Executive Committee of the Council meets on Sunday, December 28, and the council meets on the afternoon of Monday. The Academy Conference will be held on the adjournment of the council; the Secretaries Conference, beginning with a dinner, will be held on Wednesday. The annual Science Exhibition will be held in the Baker Hotel from Monday to Thursday, inclusive.

At the first general session of the association on Monday, Dr. Albert F. Blakeslee, of the Station of Experimental Evolution of the Carnegie Institution, will give the address of the retiring president entitled "Individuality and Science."

Three other general sessions will be held. On Tuesday, Dr. Edwin P. Hubble, astronomer of the Mt. Wilson Observatory of the Carnegie Institution, will give the annual lecture under the joint auspices of Sigma Xi and the association. On Wednesday evening at five o'clock the seventh annual Pi Kappa Phi lecture will be given by Dr. Rufus B. Von Klein Smid, president of the University of Southern California; the seventh Phi Beta Kappa address will be given in the evening by Dean Christian Gauss, of Princeton University.

During the week, each of the fifteen sections and the Sub-sections of Dentistry and Pharmacy will hold meetings addressed by the chairmen, who are vice-presidents of the association. There will be numerous meetings of thirty affiliated and associated societies.

The association had in 1900 about twelve hundred members. In that year SCIENCE was made the official journal, and the membership increased rapidly. When the association met in New Orleans in 1905 there were 4,321 members and 211 papers were read. There are now over 22,000 members. It is expected that at Dallas about fifteen hundred papers will be presented. In spite of war conditions it is hoped that the meeting will be of special interest and will demonstrate the fundamental importance of science for the national welfare.

## SCIENTIFIC NOTES AND NEWS

REAR ADMIRAL RICHARD E. BYRD has named a coastline area of the Antarctic Continent extending to a thousand miles "Hobbs Land" in honor of Professor William H. Hobbs, emeritus professor of geology at the University of Michigan. Hobbs Land includes the area formerly known as Ruppert Land, the Ruppert name having been given to a cape.

THE Edison Medal for 1941 has been awarded by the American Institute of Electrical Engineers to Dr. John Boswell Whitehead, director of the school of engineering of the Johns Hopkins University, "for his contributions to the field of electrical engineering, his pioneering and development in the field of dielectric research, and his achievements in the advancement of engineering education."

THE Institute for Aeronautical Sciences has awarded the Octave Chanute Award for 1941 to Melvin N. Gough, senior test pilot for the National Com-

mittee for Aeronautics Laboratories at Langley Field, Va., in recognition of "his fundamental aeronautical researches conducted on airplanes in actual flight."

SIR HENRY DALE, director of the National Institute for Medical Research, London, and president of the Royal Society, was presented with the Gold Medal of the Royal Society of Medicine at a recent meeting of the council. The medal is awarded every three years "for valuable contributions to the science and art of medicine."

DR. FRANCIS PETERSON ROUS, of the Rockefeller Institute for Medical Research, has been elected an honorary fellow of Trinity Hall, Cambridge. Dr. Rous holds the honorary degree of Sc.D. from Cambridge and was Linacre lecturer at the university in 1929.

DR. JOHN E. WEEKS, professor of ophthalmology emeritus, of the New York University College of Med-

icine, was guest of honor at a dinner given on October 6 attended by eighty friends and students.

DR. M. G. MELLON, professor of analytical chemistry at Purdue University, has been elected president of the Indiana Academy of Science.

DR. ALFRED H. WHITE, chairman of the department of chemical and metallurgical engineering at the University of Michigan, has resigned, his resignation to take effect at the end of the present semester. He will remain in the department as professor of chemical engineering. Dr. George Granger Brown has been appointed his successor.

DR. MARSHALL SOHALK has resigned as assistant geologist in the Pittsburgh office of the Gulf Oil Corporation in order to become assistant professor of geology and geography at Smith College.

DR. HOWARD A. MEYERHOFF, professor of geology and geography at Smith College, has been appointed by Governor Saltonstall a member of the Massachusetts Committee on Public Safety to serve as regional director for the region that includes seventy-two towns in Hampshire, Hampden and Franklin Counties and six towns in Worcester County.

DR. F. C. BARTLETT, professor of experimental psychology in the University of Cambridge, has been appointed a member of the British Medical Research Council to succeed the late Professor A. J. Clark.

MAURICE HOLLAND, for eighteen years director of the Division of Engineering and Industrial Research of the National Research Council, has been appointed research adviser to the Pillsbury Flour Mills Company, Minneapolis.

THE *News Edition* of the American Chemical Society states that G. J. Callister, formerly vice-president of the American Potash Institute, has been appointed for the duration of the war general secretary of the Canadian Society of Technical Agriculturalists, Ottawa.

DR. NATHAN W. SHOCK, formerly research associate, Institute of Child Welfare, and assistant professor of physiology, Medical School, University of California, has been appointed senior psychophysiologist in the National Institute of Health, U. S. Public Health Service. He will be in charge of the experimental program of the unit on gerontology of the institute, which has established a laboratory in the Baltimore City Hospitals.

THE Hoffman Scholarship of the Chemists' Club has been awarded for the year 1941-1942 to Robert T. Olsen, a candidate for the Ph.D. degree in the department of chemistry at the Massachusetts Institute of Technology. His Ph.D. dissertation will be in the

field of syntheses of coumarones. This scholarship, founded by the late Dr. William F. Hoffman, is available in alternate years; the stipend is \$800.

DR. T. DALLING, professor of animal pathology at the University of Cambridge, has retired to become the director of the British Ministry of Agriculture's Veterinary Laboratory at Weybridge.

DR. ZING-YANG KUO, director of the Institute of Physiology and Psychology at Chungking, is visiting England at the request of the Minister of Education for China and by invitation of the Universities' China Committee in London.

*Nature* reports that Bjorn Holland-Hansen, the hydrographer, head of the Meteorological Institute of Bergen, was arrested some six months ago and is still in prison.

DR. ROBERT D. GILLESPIE, London, chief psychiatrist of the British Royal Air Force, delivered on November 30 the ninth Weir Mitchell Oration of the College of Physicians of Philadelphia. His topic was "Psychoneuroses in Peace and War and the Future of Human Relationships."

DR. J. J. GALLOWAY, professor of geology at Indiana University, spent the week of October 27 to 31 as visiting lecturer in the department of geology at Smith College. On October 27 he gave a general college lecture on "Ancient Rulers of the Earth," and during the week conducted a series of seminars within the department on the following subjects: Opportunities for Women in Geology, Geologic Fallacies, Origin of Petroleum, Biologic Principles in Paleontology, Major Trends in Foraminiferal Evolution.

THE Herzstein Lectures, given in alternate years under the auspices of the School of Medicine of Stanford University and the Medical School of the University of California, will be given by Professor E. Braun-Menendez, of the Physiological Institute of the University of Buenos Aires. He will speak on March 9, 11 and 13 on "Experimental Renal Hypertension." The Morris Herzstein Lectures were established in 1929, under a provision of the will of the late Dr. Morris Herzstein, of San Francisco.

AN Associated Press dispatch states that the University of Leyden, founded in 1575, will be closed in answer to a student strike which protested against the dismissal of a Jewish professor.

A DIRECTORY of schools of agriculture in Latin America, the first publication of its kind, has been completed by the U. S. Office of Education. The publication lists by countries 182 institutions and 38 experiment stations.

SEVENTEEN physicians, specialists in various fields

in medicine, arrived recently in New York. They have been sent by the Government of Chile for a four-month course of study in American hospitals.

THE Australian government has under consideration the establishment of a National Medical Service to provide free medical treatment for every one. To put the plan into effect the expenditure of \$17,000,000 will be required, and the estimated annual cost is expected to be \$22,000,000.

The *British Medical Journal* states that the Pavlov laboratories in Leningrad are conducting research on the effect of various pharmaceutical substitutes on the higher nervous system. The work is going on regularly and systematically despite the proximity to the front.

THE American Society for X-ray and Electron Diffraction will meet at Boston on December 31. In the morning a joint session will be held with the Mineralogical Society of America in the Hotel Statler.

THE fiftieth anniversary of the founding of Drexel Institute of Technology, Philadelphia, was celebrated on December 17 at the Founder's Day ceremonies held in the college auditorium, followed by the traditional students' Christmas exercises. Members of the Drexel family, educators from neighboring colleges and schools, members of the Drexel board of trustees, and the entire faculty and student body of the college attended to pay tribute to the memory of Anthony Joseph Drexel, the Philadelphia financier and philanthropist, who founded the college in 1891. President Parke R. Kolbe presided at the exercises.

A SPECIAL tuition-fee defense course, designed to train radio technicians, is being conducted at New York University. The course, subsidized by the U. S. Office of Education, is open to twenty-five selected high-school graduates with a background of physics, chemistry and mathematics. It began on November 10 and will continue for nineteen weeks.

ACCORDING to the *Journal* of the American Medical Association, the Chicago Cancer Committee, Inc., has been organized as a liaison educational agency; Dr. Ludvig Hektoen, executive director of the National Advisory Cancer Council, is chairman. The purpose is to disseminate information on the symptoms, diagnosis, treatment and prevention of cancer, to aid indigent cancer patients to obtain treatment and to work toward the establishment of hospital and other necessary facilities. Dr. William F. Petersen, chairman of the board of governors of the Institute of Medicine of Chicago, is treasurer of the committee; the directors include Dr. John A. Wolfer, chairman of the cancer committee of the Illinois State Medical Society; Dr. Bowman C. Crowell, associate director

of the American College of Surgeons; Mrs. Arthur I. Edison, state commander of the Women's Field Army of the American Society for the Control of Cancer, and Alexander Ropchan, director of the health division, Council of Social Agencies, secretary.

THE department of medicine of the Medical School of the University of California has instituted a course on the cyclotron and its products. This course is probably the first of its kind given for a large group of medical men. Instructors are members of the staff of the Radiation Laboratory of the University of California in Berkeley, of which Dr. Ernest O. Lawrence is director. Development of the cyclotron in medical and biological research has been under the direction of Dr. John H. Lawrence, assistant professor of medicine in the Medical School, and a brother of Dr. Lawrence.

It has been the practice for professional societies in the various fields to encourage students of these professions to participate in the work of the societies, while still in college. The Institute of Radio Engineers recently took a step in this direction by appointing representatives at sixty-five educational institutions. These representatives are authorized to use the name of the institute in connection with activities carried on by student members, with the cooperation or under the supervision of the institute representative.

ACCORDING to the *Journal* of the American Medical Association the national government of Ecuador, aided by grants from the Rockefeller Foundation, has established a National Institute of Hygiene in Guayaquil as a part of the national department of health. A building has already been constructed by the government, and the Rockefeller Foundation will provide funds for equipment and contribute to the salaries of the personnel and to the general expenses. The foundation will continue its support on a decreasing scale for five years until the government takes over full responsibility. It will also provide fellowships for the training of personnel. The first director will be Dr. Atilio Macchiavello of Chile, who will hold the position for two years to complete the organization. Dr. Juan A. Montalván, a member of the staff of the health department, will then become the director. Dr. Montalván is now in the United States in training for the position. There will be departments of tropical pathology, bacteriology and immunology, epidemiology, pathology and diagnosis, chemistry and food analysis, control of biologic products, production of biologic products and a number of general services. The Rockefeller Foundation has granted fellowships for the present year to José Crusellas Ventura, who is to take charge of the department of chemistry and

food analysis, and to Dr. V. Mosquera Ferrés, who will be director of the department of pathology and diagnosis.

THE Trustees of Oberlin College recently awarded contracts for the construction of a Physics Laboratory. This is one unit of a proposed science quadrangle. A second unit, a Biology Laboratory, is in early prospect. The structural steel for both units was purchased some months ago and is on the ground. The quadrangle will be "anchored" to the present Chemistry Laboratory, chemistry being the only science at present in permanent quarters. On July 22 President Wilkins and Professor Taylor shared the ceremony of breaking ground for the physics unit, the construction of which is now under way. The laboratory will cover a space  $59 \times 194$  feet and will consist of two floors and basement. The estimated cost of the building and its furnishings is \$390,000. The architect is Edward J. Schulte, of Cincinnati. Besides unusually thorough provisions, designed under the direction of Professor C. E. Howe, for electrical distribution to student positions throughout the laboratory, this unit will house a well-equipped instru-

ment shop, including glass-blowing facilities, serving all the science departments of the college.

CONDITIONS in Russia prevented the attendance of any Russian delegates at the International Congress of Genetics held in Edinburgh in August, 1939. According to *The Journal of Heredity* up to the last minute it was expected that there would be a considerable Russian delegation at the congress. The papers or abstracts submitted by the Russian delegates were on file with the Secretariat of the congress at the time it was held. Since these papers were not read by the authors they were not included in the proceedings, which have recently been published. It is the wish of many of the Russian workers that these papers somehow be made available as a matter of permanent record. The papers dealing with *Drosophila* are being issued by the *Drosophila* Information Service and thus will be available. Through the instrumentality of the American Documentation Institute the other contributions are being afforded supplemental publication so that genetic workers can obtain them as microfilms or as photo-prints.

## DISCUSSION

### MEAN SEA-LEVEL AND SAND MOVEMENTS

A RELATION between mean sea-level and the height of sand along the pier at the Scripps Institution of Oceanography at La Jolla, Calif., was shown by La Fond.<sup>1</sup> He stated: "It should not be concluded that the rise in sea-level alone causes a building up of the sand, but many of the factors which influence the sea-level must likewise affect the sand movements." The conclusion that the rise in sea-level in any way causes the change in sand level can not be sustained; however, the factors which cause the changes in sea-level likewise change the shore-line shape so that a retreat or advance of the mean high-tide line (used for convenient reference only) will appear as a depth change along a fixed reference line, such as the La Jolla pier, where accurate measurements of position are easily made.

Fig. 1 shows the height of mean sea-level on the La Jolla tide staff, and the average height of the sand at fifty equally spaced stations along the pier. The data of La Fond are not included; the additional data were furnished by Dr. H. U. Sverdrup, director of Scripps Institution of Oceanography.

The flow of water past a headland projecting into the stream will induce an eddy current to form in the bight in the lee of the headland, causing the shore-line to take the form of a logarithmic spiral.<sup>2</sup> When sea-level is high along the Pacific Coast of the United

States, it is low along the South American coast, necessitating an interchange of water between the hemispheres. Upwelling and prevailing winds also influence currents.<sup>3</sup>

The shore-line shapes resulting from current reversals will then be similar to those shown in Figs. 2A and 2B; when those two forms are superimposed, as in Fig. 2C, the retreat and advance of the high-water lines become apparent. La Jolla is situated in a position similar to the area marked "X." Had simultaneous observations been taken at position "Z," an increase in the sand height would have been noted during the fall in the sea-level height, while in the vicinity of "Y" no change in sand height would have been found, other than minor oscillations. This can be shown more easily by a survey of the shore-line in the bight during March and another in September, accurately locating a particular contour near the high-water line.

The seasonal travel of sand between the rocky headlands which form the California coast has long been observed, although no adequate explanation has been given. However, competent observers have noted the summer and winter oscillations and have concluded that but little sand passes the headlands, the quantity on each section of beach remaining approximately constant, recognizing that stream additions of sand occur in some bights and wind denudations in others. This view is reached by examination of the rock

<sup>1</sup> Eugena La Fond, *SCIENCE*, July 29, 1938.

<sup>2</sup> Harry Leyboldt, *Shore and Beach*, January, 1941.

<sup>3</sup> *Ibid.*, U. S. Naval Institute Proceedings, May, 1939.

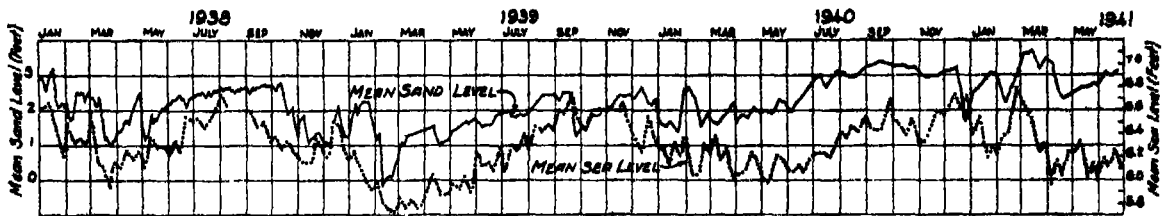


FIG. 1. Relation between mean sea-level on tide staff at La Jolla, California, and mean sand level along Scripps Institution pier, above arbitrary datum.

formations at the headlands. These retain sharp definition. Passage of large quantities of sand in either direction would quickly smooth the rocks. Also, the rocky points are usually heavily covered by kelp beds close inshore which grow on roots firmly anchored to a rocky bottom, precluding the possibility of sandy bottom at these points, therefore the passage of sand thereover.

The shorter periodical reversals of currents, caused by upwelling, winds and tides, also will move the shore-line to and fro, with the resulting change in sand height, accounting for the shorter period changes. Grant and Shepard<sup>4</sup> discussed the data of La Fond and others but reached the erroneous conclusion that the sand moved "onshore and offshore by waves of oscillation when they get into shallow water." They also stated: "During the winter stormy period the material is shifted out from the foreshore and deposited on the sea floor along the outer portion of the pier. In the summer the material creeps back to the foreshore." No attempt is made to explain this bizarre action of the sand "creeping back to the foreshore in the summer" or how an offshore component sufficient to carry sand offshore for a thousand feet

or more is introduced into the waves of oscillation, practically all of which approach the beach from seaward. Similarly vague was the discussion of the current reversal cause.

"Observations at the Scripps pier show that a current ranging up to 2,000 feet per hour runs along the shore. This current frequently reverses its direction because of local conditions" (*italics mine*).

The effort to explain the phenomenon by introducing undiscovered and probably non-existent forces which cause a sand movement on and off-shore (normal to the shore-line), when the well-known lateral sand movements as shown herein amply cover the situation, is unwarranted and unsound.

From the foregoing, it is apparent that the sand height is not a function of the sea-level height. The former is dependent upon the littoral current direction and the shoreline-shaping tendencies of induced eddies, while the current is a function of several factors, one of which is the height of local sea-level in relation to the sea-level height in other portions of the same oceanic basins. Sea-level heights are functions of rainfall in the locality, together with river discharge and other methods of ground-water return, and water removal for rainfall.

The only conclusion which can be drawn from the

<sup>4</sup> U. S. Grant and F. P. Shepard, *Proceedings of the Sixth Pacific Science Congress*, 1939.

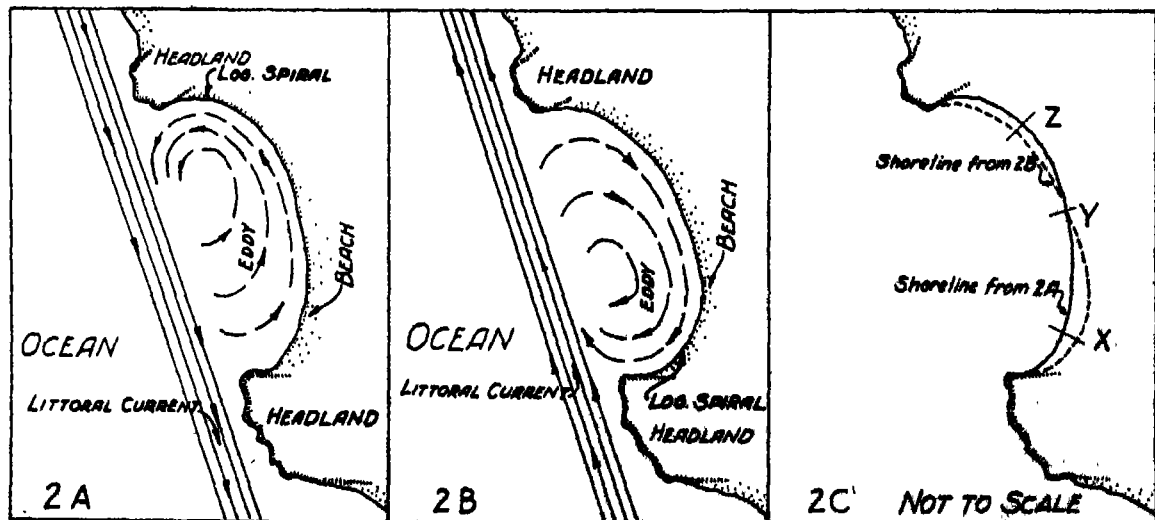


FIG. 2. Shore-line changes from reversal of littoral currents.

sand movements is that a reversal of littoral currents is generally reflected in a consistent change in sea-level height without indicating the relation which probably exists between sea-level and currents.

HARRY LEYPOLDT

LOS ANGELES HARBOR DEPARTMENT

### ZIPF'S "LAW OF URBAN CONCENTRATION"

IN the August 15th issue of *SCIENCE*, Alfred J. Lotka points out that the law of urban concentration described by G. K. Zipf in his recent book, "National Unity and Disunity," is not particularly striking and at least not novel, citing a number of cases where the type of frequency distribution utilized by Zipf has been found applicable but where such application has thrown little light upon the relevant functional relationships.

It should also be pointed out that Zipf has attempted to apply the harmonic series frequency law to the frequency distributions of words in English, German, and several other languages.<sup>1</sup> Here, too, Zipf's work was foreshadowed, *viz.*, by E. V. Condon's article, "Statistics of Vocabulary."<sup>2</sup> Though Condon was not able to utilize the empirical data available to Zipf, his mathematical formulation was as adequate as that of Zipf. It is well to note, however, that the harmonic series law has a semblance of good fit to linguistic data only in selected cases—generally where the samples of words are of moderate size (not over, say, 100,000 words) and are taken from written material such as newspapers, books, etc. I have tried without success to apply the law to distributions of words in telephone conversations,<sup>3</sup> in children's speech and in stories written for children.

Finally, I wish to draw attention to a certain mathematical limitation to the application of the harmonic series law. This limitation has been discussed by me previously<sup>4</sup> and can be shown to apply to Zipf's latest contribution. We may first regard the population of an area as analogous to the number of words in a sample ( $N$ ) and the number of cities, towns and villages in an area as analogous to the number of different words in a sample ( $d$ ). We may then write Zipf's law as  $f r^x = \frac{N}{k}$ , where  $f$  denotes frequency (analogously, population of a city, town or village),  $r$  denotes rank, and  $k$  and  $x$  are parameters. As shown in my article, the harmonic series law can not hold for a sample where  $N > dk$ , at least where  $x = 1.00$ .

JOHN B. CARROLL

MOUNT HOLYOKE COLLEGE

<sup>1</sup> "The Psycho-Biology of Language," Boston, 1935.

<sup>2</sup> *SCIENCE*, 67: 300, 1928.

<sup>3</sup> N. R. French, C. W. Carter, Jr., and W. Koenig, Jr., *Bell System Technical Journal*, 9: 290-324, 1930.

<sup>4</sup> J. B. Carroll, *Psychol. Record*, 2: 379-386, 1938.

### "THE BREATHING MECHANISM OF TURTLES"

THE discussion of turtle breathing by Dr. Hansen in a recent issue of *SCIENCE*<sup>1</sup> expresses justifiable impatience with a perpetuation of error by modern textbooks. My reaction to the conflicting statements from different sources about this subject led me in 1939 to start an investigation of turtle respiration using physiological technics. This work is progressing and a report should soon be possible.

It should be pointed out, however, that although the sources quoted by Dr. Hansen—especially the splendid morphological study and deductions of Mitchell and Morehouse, who *appeared* to have settled the question as early as 1863 with little recourse to experimental work—seem to make his own observations a reemphasis of fact from the last century, actually the case is not at rest. Those who talk of throat movements in turtles as breathing action can support their statements by contemporary experimental data. For example, Lüdicke<sup>2</sup> in 1936 appears to arrive at the compromise conclusion that the difference between land turtles (*Testudo*) and aquatic (*Emys*) is that aquatic types swallow air and land types can not. He made observations, like Dr. Hansen's, of cannulized tracheae and collapse of lungs upon opening the body cavity.

My results with an equally aquatic species (*Malaclemys centrata*—diamondback terrapin) do not agree with Lüdicke's. A presentation of experimental evidence and attempts to reconcile conflicting observations can not be done in this comment. I concur in the essential point (but not in his details) of Dr. Hansen's discussion. The primary breathing mechanism in turtles is the movement of muscular diaphragms located at each leg pocket in the shell and ventral to the viscera, together with the muscular closure of the opening in the glottis.

Present writers of text-books who discuss turtle respiration will need to deal with the striking, and misleading, hyoid movements. They appear from records now on hand to be definitely correlated with sensory rather than respiratory functions, and they are almost certainly olfactory.

F. H. MCCUTCHEON

NORTH CAROLINA STATE COLLEGE

### ON THE OCCURRENCE OF STEREOISOMERIC CAROTENOIDS IN NATURE

It was reported recently<sup>1</sup> that the ripe fruits of the Tangerine tomato (a variety of *Lycopersicum*

<sup>1</sup> Ira B. Hansen, *SCIENCE*, 94: 64, 1941.

<sup>2</sup> M. Lüdicke, *Zool. Jahrb. Abt. Allg. Zool. u. Physiol.*, 56: 83-106, 1936.

<sup>3</sup> L. Zechmeister, A. L. LeRosen, F. W. Went and L. Pauling, *Proc. Nat. Acad. Sciences*, 27: 468, 1941.

*esculentum*) contain a new carotenoid, prolycopene,  $C_{40}H_{56}$ , which on treatment with iodine is rapidly converted into a pigment mixture in which lycopene, the red pigment of the ordinary tomato fruit, predominates. Whereas lycopene possesses the trans configuration throughout, all or most of the double bonds which are available for stereochemical changes are present in their cis form in prolycopene.

Assuming that representatives of the new class of carotenoids are wide-spread in nature, even though their quantity may be small, we tested a series of plant materials in this respect. It was found that a new carotenoid occurs in some palm fruits, viz., *Butia eriospatha* and *B. capitata* (Becc.). It can be crystallized and shows in petroleum ether absorption maxima at 462 and 432.5  $m\mu$ . On addition of some iodine to the solution contained in a spectroscopic cell, the typical three-banded spectrum of  $\gamma$ -carotene appears almost immediately. The maxima are now at

493.5, 461 and 431  $m\mu$ . They have somewhat shorter wave-lengths than pure  $\gamma$ -carotene (496, 461.5 and 433.5  $m\mu$ ) due to the presence of subsidiary stereoisomers. The new pigment has been termed *pro- $\gamma$ -carotene*. In *B. capitata* it is accompanied by prolycopene from which it can easily be separated on the chromatographic column.

The fruits of *Pyracantha angustifolia* (Scheid.) contain pro- $\gamma$ -carotene and at least two different prolycopenes.

Further experiments now in progress in this laboratory may reveal other examples of the occurrence of such carotenoids which are stereochemically different from representatives of the well-known all-trans series.

L. ZECHMEISTER

W. A. SCHROEDER

GATES AND CRELLIN LABORATORIES  
OF CHEMISTRY,  
CALIFORNIA INSTITUTE OF TECHNOLOGY

## SPECIAL CORRESPONDENCE

### LETTER FROM DOUGLAS COCKERELL, LEITCHWORTH, ENGLAND, OCTOBER 1, TO HIS BROTHER IN COLORADO

THE three-day meeting of the British Association in London has been a notable event. A. Huxley describes it as being the most important scientific meeting ever held. A lot of wise things were said by important people bearing on the function of science in the reconstruction after the war. A sort of "Atlantic charter" for science was promulgated, emphasizing the unity of science throughout the world in spite of racial and political divisions. It was stated that now for the first time we had a provisional standard of the minimum requirement in food to produce the maximum health, and that some three fifths of the people of the world were living below this standard, so we had a very definite aim in front of us. Altogether, as might have been expected from a body of scientists drawn from all over the world, a larger view of world problems was taken than we have had from our politicians.

I have been reading an account of a fanatical sect that existed in the midlands in the early part of the nineteenth century. They were convinced that the end of the world was imminent, and so took no consideration for the future, living from hand to mouth from day to day.

I notice a somewhat similar state of mind developing in connection with the war conditions. The future is so uncertain. I don't think that there is any fear of the country being conquered, but there is great uncertainty about what the conditions will be after the war, particularly about the value of money. People

generally are, I think, in a mood to face and accept great changes if these are ably advocated; wise leadership is what is wanted, and the British Association meeting, by lifting the world problems out of narrow nationalistic grooves, may have a far-reaching effect on world opinion. Anyway it seems to have set a standard to be aimed at, and the political and diplomatic people appeared to agree with the suggestions put forward. The churches, too, are stirring, and taking a much wider view, and there is a marked revival of religious feeling, and a groping for some sort of guidance quite beyond the dogmas of the different sects.

Something great may come out of all this, but at present all seems to be in solution, and what will precipitate out we can not tell.

In the meantime we live on from day to day, not unhappily, but in a fog of uncertainty about the future.

T. D. A. COCKERELL

BOULDER, COLORADO

### POST-GRADUATE COURSE IN TROPICAL MEDICINE AT TULANE UNIVERSITY, 1941-1942

DURING the first half of the academic year 1941-1942 a comprehensive post-graduate course in tropical medicine has been conducted at Tulane University under the auspices of the department of graduate medicine. There are seventeen enrollees, including nine from Latin-America, seven from the United States and one from Canada. Of the Latin-American group two are from Brazil, one from Chile, one from Colombia,

two from Guatemala and three from Mexico. Eight of these nine were selected for fellowship awards of the American Foundation for Tropical Medicine following careful scrutiny of a large group of endorsed applications. Some of the North American physicians in attendance plan to practice in missionary stations in Africa, India and the Netherlands East Indies; others expect to specialize in tropical medicine in the United States or with the defense forces.

The course is carefully integrated and consists of lectures, conferences, quizzes, laboratory, clinic and hospital practice covering the fields of hematology (16 hours), protozoology (40 hours), helminthology (40 hours), medical entomology (40 hours), tropical bacteriology (48 hours), mycology (32 hours), tropical pathology (24 hours), tropical surgery (12 hours), deficiency diseases (24 hours), preventive medicine and public health (24 hours). Approximately 120 of the total of 412 scheduled hours consist of work with patients in the wards of Charity Hospital in New Orleans.

This course is in charge of eight full-time staff members of the Tulane Department of Tropical Medicine, supplemented by time contributed by members of the departments of medicine, surgery, pathology and preventive medicine and public health of Tulane University, as well as of the Louisiana State Department of Health and U. S. Quarantine Service in New Orleans. In addition, the following guest lecturers, specialists in their subjects, have contributed to the success of the course:

Dr. Clarence A. Mills, professor of experimental medicine, University of Cincinnati, "Tropical Climatology" (October 8-10).

Dr. George W. McCoy, director, department of public

health, Louisiana State University Medical School, "Plague and Tularemia" (October 29-30).

Dr. Herbert C. Clark, director, Gorgas Memorial Laboratory, Panama, "Malaria" (November 17-18).

Dr. G. H. Faget, senior surgeon, medical officer in charge, U. S. Marine Hospital, Carville, La., "Leprosy" (November 18-19).

Dr. C. G. Eccles, pathologist, U. S. Marine Hospital, Carville, La., "Pathology of Leprosy" (December 2).

Dr. A. W. Sellards, associate professor of comparative pathology and tropical medicine, Harvard Medical School, "Yellow Fever and Dengue" (November 24-25).

Dr. Rolla E. Dyer, director, division of infectious diseases, National Institute of Health, Bethesda, Md., "Typhus and Tick Fevers" (November 27-28).

Dr. E. B. Vedder, Colonel, M. C., U. S. A. (retired), professor of experimental medicine, the George Washington University, Washington, D. C., "The Deficiency Diseases," "Cholera" (December 8-13).

Dr. E. R. Kellersberger, general secretary, American Mission to Lepers, for twenty-four years missionary physician in the Belgian Congo, "Medical and Human Aspects of African Trypanosomiasis and Leprosy" (December 12).

No academic degree is awarded but a certificate is given to enrollees after successful completion of this work.

With the full endorsement and whole-hearted support of the American Society of Tropical Medicine, the American Academy of Tropical Medicine and other interested groups, it is expected that this course in tropical medicine at Tulane University will become a permanent contribution to American medical education.

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## SCIENTIFIC BOOKS

### GASES

*The Separation of Gases.* By M. RUHEMANN. Oxford University Press, xiii and 279 pages. 1940. \$5.75.

THE importance of natural gases and all the primary gaseous products of industrial processes and the necessity of some degree of gas separation and purification in order that these gases may be used more economically is too well known and appreciated to need comment. The technique and theory of the process of separation of gaseous mixtures, mainly by liquefaction at low temperatures, has developed rapidly in recent years and in other countries—notably Russia—the knowledge and experience acquired by workers in the field have gone far toward establishing low-temperature gas separation as a field of applied science. Moreover, it is claimed that in the near future

all gases used in bulk commercially will probably first be separated, at least partially, into a number of constituents, with a great gain in efficiency. Nevertheless, it is the author's contention that this "deep refrigeration," as it is called, has not received the attention it deserves from physicists, chemists and engineers in this country. It is with the intention of stimulating investigation in this field, and making the information already acquired available in English, that this book was written. While, according to the author's preface, the book is designed, in large degree, for those who may be instrumental in training future workers, it is the reviewer's opinion that the subject matter will appeal mostly to those already engaged as scientists or engineers in industrial laboratories where gas products are an important consideration. However, it must be stated that there is

a great deal which is useful for the production of such low temperatures as may be attained by mechanical means and the book is therefore of interest for research of a more academic nature.

Since the value of a book dealing with a rather specialized subject depends so greatly on the detailed nature of the information presented, the following brief description of contents is given. After a short introduction dealing with general principles involved in gas separation the author reviews in Chapter I the gas mixtures of greatest importance from the industrial point of view. As a preparation for the problems involved in the separation and therefore of primary importance for the design of the separating plant, the equilibrium of vapor-liquid systems (binary and ternary) is treated in Chapter II. While the discussion is presented in an entirely adequate manner some readers will no doubt find it necessary to consult more detailed texts. For instance, although frequent use is made of the phase rule no explicit statement of it is made. This chapter also contains useful equilibrium diagrams for a number of gas mixtures (pp. 44-59). The methods of gas separation and a discussion of the pertinent thermodynamical principles are presented in Chapters III and IV, and in Chapter V refrigeration as applied to gas liquefaction is treated in detail. The remainder of the book is concerned with the separation of special gas mixtures the most important of which is air. Chapters VI to IX are devoted to a discussion of the types of separation plants, the efficiency of various separation methods and the effect of the non-binary character of air, with especial reference to the extraction of rare gases from the atmosphere. The final chapters, X to XII, deal with coke-oven gas, the production of methane and helium and the separation of olefines from cracker gas.

In summary the reviewer feels that this book should be very useful in its field of application and would be more so if greater emphasis had been placed on experimental data.

### ATOMS

*The World and the Atoms.* By C. MÖLLER and E. RASMUSSEN, with a foreword by NIELS BOHR. Translated from the second Danish Edition. 193 pages and 40 figures. D. Van Nostrand Company, 1940. \$2.75.

THAT "The World and the Atoms" gives to its readers an admirable account of the fascinating discoveries of modern physics and of the important basic concepts to which they have led is in itself a sufficient recommendation of this most enjoyable book. It is perhaps equally noteworthy that the complementary nature of theory and experiment, so essential for the progress of physical science, is more than adequately expressed. The development of atomic physics starting from the discovery of radium and culminating in the contemporary researches into the atomic nucleus is traced in a very logical and understandable manner—with no mathematics more complicated than multiplication. It is unfortunate that the date of writing prevented more than a brief mention of cosmic radiation.

While no serious fault is to be found with the translator's version the substitution of *brass* for *messing* (facing page 78), *sodium* for *natrium* (Fig. 14) and *tungsten* for *wolfram* (Fig. 21) would have been preferable. Fig. 27 contains a misprint in that the last element of the radioactive chain pictured should be an isotope of *lead* and is therefore *stable* rather than *stabbe*.

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## SPECIAL ARTICLES

### THE PROTECTION OF MICE AGAINST INFECTION WITH AIR-BORNE INFLUENZA VIRUS BY MEANS OF PROPYLENE GLYCOL VAPOR

SINCE our earlier report on the germicidal action of certain glycols dispersed as fine droplets (aerosols),<sup>1</sup> we have found that the vapors of these compounds exert a rapid and highly bactericidal effect on air-suspended bacteria.<sup>2</sup> Our studies show that the

<sup>1</sup> O. H. Robertson, E. Bigg, B. F. Miller and Z. Baker, *SCIENCE*, 93: 213, 1941.

<sup>2</sup> O. H. Robertson, E. Bigg, B. F. Miller, Z. Baker and T. T. Puck, *Transactions of Assoc. of Amer. Physicians*. In press.

lethal action of glycol aerosols is due principally to the liberation of gas by rapid evaporation of the aerosol droplets. When employed in the gaseous form the amounts of glycol required for effective air sterilization are much smaller than when the substance is introduced as an aerosol. Continued accumulation of evidence indicates that propylene glycol is the agent of choice for this method of killing air-borne bacteria because of its high bactericidal activity and low toxicity for the body as compared with other glycols.

In order to test the action of propylene glycol vapor on influenza virus it was first necessary to devise a simple and effective means of recovering this virus

from the air. The only data we have found in the literature on this subject are in a paper by Andrewes and co-workers,<sup>3</sup> in which a very brief statement was made to the effect that by the use of bactericidal mists, presumably NaOCl, they found that a few viruses, including influenza, were susceptible to the mist action as judged by their reduced infectivity for mice. No mention was made of the method of testing. Since the most direct and convincing method of determining the antiviral effect of propylene glycol vapor would be protection against air-borne infection, experiments were undertaken toward that end. That spontaneous experimental infection with influenza virus from infected to normal animals does occur by the aerial route has been shown by Andrewes and Glover<sup>4</sup> in experiments with ferrets. Eaton's<sup>5</sup> observation that normal mice may contract influenza from close contact with infected mice provides suggestive though not conclusive evidence for droplet infection.

Our experiments consisted in exposing 5 to 10 gram mice in a 60 liter glass-walled chamber to mouse-adapted influenza virus<sup>6</sup> (the PR8 strain of Francis<sup>7</sup>) in the form of a fine mist produced with a Graesser atomizer.<sup>8</sup> The virus, consisting of dilutions of finely ground infected mouse lungs suspended in broth containing 20 per cent. normal horse serum, was sprayed into the chamber in quantities of 0.2 to 1 cc. The mice were exposed to the virus mist for periods of time ranging from 5 minutes to 1 hour. Exposure of several hundred mice to sprays of  $10^{-2}$  dilution of the virus resulted regularly in extensive consolidation of the lungs and death within 4 to 10 days. Less numerous tests with higher dilutions of virus have shown that pulmonary lesions are produced constantly with amounts as small as  $10^{-4}$  but not all the animals succumb to the infection at this dilution. Still higher dilutions produced pulmonary lesions occasionally, but no deaths.

Experiments on the protective action of propylene glycol vapor were carried out as follows: Mice were placed in a chamber into which propylene glycol vapor was introduced in concentrations of 1 gram of propylene glycol to two to three million cc of air.<sup>9</sup> Then 0.2 to 1 cc of a  $10^{-2}$  dilution of the virus was sprayed into the chamber and the mice exposed for periods of 15 minutes to 1 hour. All these animals remained

well, whereas the control mice similarly exposed to the same suspension of influenza virus alone died within 4 to 10 days of influenza and showed extensive consolidation of the lungs from which the virus was recovered. In other experiments the test mice were killed after 6 to 8 days to determine whether they had been completely protected against infection. A protocol of one such test is shown in Table 1. In this

TABLE 1  
PROTECTIVE ACTION OF PROPYLENE GLYCOL VAPOR

	Amount of virus sprayed into chambers	Result
32 mice in chamber containing glycol vapor 1:2,000,000	0.39 cc $10^{-2}$ dilution	All remained well; killed 8th day; lungs normal*
35 mice in control chamber	0.37 cc $10^{-2}$ dilution	All died 6-10 days with extensive consolidation of lungs

\* One mouse showed a small area of consolidation about one mm in diameter in the left upper lobe

particular experiment the mice were shielded from the spray during the introduction of the virus. They were kept in the chambers for 30 minutes. The fact that mice in the propylene glycol atmosphere were exposed in many instances directly to the influenza virus spray, yet failed to contract infection suggests that the interaction between vapor and virus droplets is exceedingly rapid and may approach the rate at which the glycol vapor kills bacteria suspended in air.<sup>10</sup>

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# PROPERTIES OF THE ISOLATED MACROMOLECULAR COMPONENT OF NORMAL CHICK EMBRYO TISSUE<sup>1</sup>

STUDIES on the ultracentrifugal isolation of the equine encephalomyelitis virus<sup>2</sup> revealed the presence

<sup>10</sup> When these experiments had been largely completed, the senior author received a manuscript by Drs. Werner Henle and Joseph Zellat, in which they reported the protection of mice against air-borne influenza virus by means of propylene glycol aerosol. These authors adapted the technique previously described by us (SCIENCE, 93: 213, 1941) to their particular experiments with the virus.

<sup>1</sup> This work was aided by the Dorothy Beard Research Fund and by a grant from Lederle Laboratories, Inc., Pearl River, N. Y.

<sup>3</sup> C. H. Andrewes, *Lancet*, 2: 770, 1940.

<sup>4</sup> C. H. Andrewes and B. E. Glover, *Brit. Jour. Exp. Path.*, 22: 91, 1941.

<sup>5</sup> M. D. Eaton, *Jour. Bact.*, 39: 229, 1940.

<sup>6</sup> We are indebted to Dr. Thomas Francis, Jr., and Dr. Frank Horsfall, Jr., for supplying us with this strain of virus. Their methods for preparation of the virus suspensions have been used in these experiments.

<sup>7</sup> T. Francis, Jr., *SCIENCE*, 80: 457, 1934.

<sup>8</sup> J. B. Graesser and A. H. Rowe, *Jour. Allergy*, 6: 415, 1935.

<sup>9</sup> The methods employed will be described in detail in a subsequent publication.

in diseased chick embryo tissue of two heavy components, one with a sedimentation constant of  $S_{20,0} = \text{ca } 250 \times 10^{-13} \text{ cm sec}^{-1} \text{ dynes}^{-1}$  and the second with a sedimentation constant of  $S_{20,0} = \text{ca } 70 \times 10^{-13} \text{ cm sec}^{-1} \text{ dynes}^{-1}$ . The former is present only in diseased tissue, while a component similar to the latter is found also in normal chick embryo tissue.<sup>2</sup> In the earlier experiments both components obtained from diseased tissue appeared equally infectious. Subsequent experiments have indicated that the heavier material with  $S_{20,0} = 253 \times 10^{-13} \text{ cm sec}^{-1} \text{ dynes}^{-1}$  represents the equine encephalomyelitis virus.<sup>4</sup> However, in order to eliminate the possibility of some relation between the virus complex and the lighter component of diseased tissue, systematic studies have been made of the properties and the behavior of the latter.

Since infectivity of the lighter material from diseased embryos could have been due to contamination<sup>2</sup> with small quantities of the virus complex, a better separation was sought by changes in the isolation technique. This has been accomplished by the extraction with distilled water of diseased embryo tissue for 42 to 96 hours without adjustment of pH. The extracts, filtered through celite, were then subjected to two or three cycles of alternate low- and high-speed centrifugation at 17,000 g and 67,000 g for 15 and 30 minutes, respectively. Distilled water was the solvent throughout, the pH remaining between 7.2 to 7.4. The significant changes were: (1) prolonged extraction (42 to 96 hours as compared with two hours previously used); (2) pH (7.2 to 7.4 instead of 8.5 to 9.0) and (3) filtration with celite.

The procedure yields a product entirely different with respect to infectivity from that previously reported. While infectivity is practically always associated with the material, the infectious unit has been  $10^{-8}$  grams or greater, a difference of the order of 100,000 or more in comparison with the unit of the virus complex, which is consistently  $10^{-13}$  to  $10^{-14}$  grams.<sup>2</sup> These findings substantiate the suspicion of previous imperfect separation of the two components. Studies on the nature and properties of the lighter component indicate that it is in no way related to the virus complex.

Solutions containing 1 mg or more of the lighter

component from diseased or normal tissue per cc are opalescent and, in the higher concentrations, exhibit a distinct yellow cast. The material is precipitated by the usual protein coagulants and gives positive xanthoproteic, Millon and biuret tests, but a negative glyoxylic acid test. The Molisch test is negative, while that for pentose with Bial's reagent and the acrolein test for fat are strongly positive. Heat coagulation occurs at 73 to 76° C. The yield has varied from 1 to 4 mg per gram of embryo tissue. The ultraviolet absorption spectrum showed a maximum at 2600 Å.

Analysis of 440 mg of the substance, dialyzed against distilled water and dried from the frozen state and further dried to constant weight over  $\text{P}_2\text{O}_5$ , revealed an elementary constitution of C, 55.2; H, 8.3; N, 9.5; P, 2.3; and S, 0.22 per cent. Extraction successively with acetone, alcohol-ether (1-1) and benzene revealed a fat content of 34.6 per cent. of which phospholipid constituted 67.0; cholesterol, 18.4; and fatty acid 20 per cent. The total carbohydrate of the whole complex was 7.0 per cent. The partial specific volume by pyknometer measurement was 0.79, corresponding to a specific gravity of 1.27.

Fractionation of 181 mg of the lipid-free fraction for nucleic acid yielded 28.5 mg of a white amorphous product giving a positive Bial's test but negative Feulgen and diphenylamine tests. The biuret test was negative. On hydrolysis crystalline adenine picrate was isolated, and the murexide test for guanine was positive. Tests for cytosine or uracil of both were positive. The test for thymine was entirely negative. This ribonucleic acid represented 10.5 per cent. of the whole complex, and the ultraviolet absorption curve was indistinguishable from that obtained with yeast nucleic acid.

Ultracentrifugal sedimentation diagrams of the undamaged material reveal sharp boundaries indicative of high homogeneity, comparable in this respect to the papilloma virus protein<sup>5</sup> and the equine encephalomyelitis virus complex.<sup>6</sup> The sedimentation constant at pH 7.0 in water is  $S_{20,0} = 73 \times 10^{-13} \text{ cm sec}^{-1} \text{ dynes}^{-1}$  and in borate buffer solution at the same pH  $S_{20,0} = 78.7 \times 10^{-13} \text{ cm sec}^{-1} \text{ dynes}^{-1}$ . Molecular stability studied in 0.005 M buffer solution by means of the analytical ultracentrifuge was at a maximum between pH 7.0 and 8.2, precipitation occurring at pH 4.8, degradation above pH 8.3 to smaller relatively homogeneous fragments. The complex is extremely salt labile, breaking down in three or four days even in 0.005 M salt solutions.

Comparison of the properties of the lighter com-

<sup>2</sup> A. R. Taylor, D. G. Sharp, H. Finkelstein and J. W. Beard, *Proc. Soc. Exp. Biol. and Med.*, 42: 462, 1939.

<sup>3</sup> D. G. Sharp, A. R. Taylor, H. Finkelstein and J. W. Beard, *Proc. Soc. Exp. Biol. and Med.*, 42: 459, 1939. It should be emphasized that this component is wholly different from the normal chick embryo component of Claude (Proc. Soc. Exp. Biol. and Med., 39: 398, 1938) reported (K. G. Stern and F. Duran-Reynals, *SCIENCE*, 89: 609, 1939) to have a sedimentation constant of  $S_{20,0} = \text{ca } 532 \times 10^{-13} \text{ cm sec}^{-1} \text{ dynes}^{-1}$ .

<sup>4</sup> D. G. Sharp, A. R. Taylor, D. Beard, H. Finkelstein and J. W. Beard, *SCIENCE*, 92: 869, 1940.

<sup>5</sup> J. W. Beard, W. R. Bryan and B. W. G. Wysocki, *Jour. Infect. Dis.*, 65: 48, 1939.

<sup>6</sup> A. R. Taylor, D. G. Sharp and J. W. Beard, *Jour. Infect. Dis.*, 67: 59, 1940.

ponent with those of the virus complex<sup>4,6</sup> reveals pronounced differences. Further, in the degradation of the virus complex by any means yet studied, no material with  $S_{20,0} = \text{ca } 70 \times 10^{-13} \text{ cm sec}^{-1} \text{ dynes}^{-1}$  has been seen. It appears reasonable to conclude that the lighter component in diseased embryo tissue is identical with that of normal chick embryo tissue and as such is not specifically concerned with the disease process associated with the virus.

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### CRYSTALLINE CATALASE FROM BEEF ERYTHROCYTES

As early as 1911 Wolff and de Stoecklin<sup>1</sup> obtained rather highly purified catalase solutions from erythrocytes (species not stated). In 1923 Tsuchihashi<sup>2</sup> described a method for the purification of the horse erythrocyte catalase.

In our laboratory Tria<sup>3</sup> made considerable progress in purifying the catalase of beef blood, and recently A. L. Dounce<sup>4</sup> obtained this catalase in crystalline condition. But Dounce's method is time-consuming and the yield is very small.

We have prepared crystalline catalase from washed and laked cow erythrocytes by the following steps:

1. Adsorption on aluminum hydroxide<sup>5</sup> at pH 5.7, repeated washing of the adsorption complex with dilute acetate buffer pH 5.5, and elution with M/10 phosphate buffer at pH 8.0.

2. Precipitation at pH 5.7 with 30 gm ammonium sulfate for every 100 cc of enzyme solution. This

precipitation was then repeated, using one tenth of the initial volume.

3. Dialysis, followed by precipitation at pH 5.5 by enough alcohol to make 40 per cent. concentration.

4. Solution in 1.25 per cent. NaCl and adsorption at pH 5.5 on  $\text{Al}(\text{OH})_3$  followed by elution with phosphate buffer pH 8.0 (no preliminary washing).

5. Precipitation of the eluted catalase with 30 gm of solid ammonium sulfate per 100 cc, at pH 5.7. The precipitate is mixed with a minute amount of water, centrifuged and allowed to stand in the ice-chest. Crystals form. The yield is increased by adding saturated ammonium sulfate slowly.

The catalase obtained by this method had a "Kat.f" of 43,000 and the crystals had the shape of small needles. After a second recrystallization from ammonium sulfate solution the crystals were mostly plates, while the "Kat.f." was 48,000. The iron content was 0.12 per cent. The visible absorption spectrum is identical with that for liver catalase.

Unlike crystalline beef liver catalase, erythrocyte catalase gives no blue color upon treatment with acetone and hydrochloric acid, but a reddish-brown color. The reddish-brown material has been identified as hemin.

These preliminary findings indicate that beef erythrocyte catalase differs from beef liver catalase in possessing a greater activity and in lacking prosthetic groups which furnish the "blue substance" or biliverin.

One of us (M. L.) wishes to express his sincere gratitude to the Rockefeller Foundation for both the material and moral support.

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## SCIENTIFIC APPARATUS AND LABORATORY METHODS

### A GRINDER FOR HOMOGENIZING BACTERIAL CLUMPS OR INFECTED TISSUES

THE problem of preparing homogeneous suspensions of acid-fast bacteria, infected tissues or small amounts of various substances in the laboratory has long since resulted in the production of various grinders to facilitate the process. Recently, the need arose for a considerable supply of sterile grinding devices for homogenization of leprosy nodules to recover the bacilli. It was found that remarkably com-

plete homogenization and suspension of subcutaneous nodules, after they were cut down to small pieces by means of scissors, could be brought about in Pyrex grinders of the type illustrated in Fig. 1.

The important features in the construction of such grinders are: (a) selection of pairs of tubes so that one fits closely within the other, (b) careful boring of the holes in the rubber stoppers which join the inner grinding tube to the glass-shaft, and (c) grinding of the paired tubes with emery powder in water to produce roughened surfaces which rotate against each other without letting the small bits of tissue lodge where they may escape grinding. Due to the type of joint used, the inner grinding tube never rotates perfectly on its axis, but has a wobble which causes it to scour the walls of the outer tube. The rotating shaft

<sup>1</sup> J. Wolff and E. de Stoecklin, *Compt. Rend. Acad. Sci.*, 152: 729, 1911.

<sup>2</sup> M. Tsuchihashi, *Biochem. Zeitschr.*, 140: 63, 1923.

<sup>3</sup> E. Tria, unpublished.

<sup>4</sup> A. L. Dounce, unpublished.

<sup>5</sup> G. Tracey and W. H. Walker, *Jour. Biol. Chem.*, 22: 55, 1915.

<sup>6</sup> Present address: Division of Agricultural Biochemistry, University of Minnesota, St. Paul, Minn.

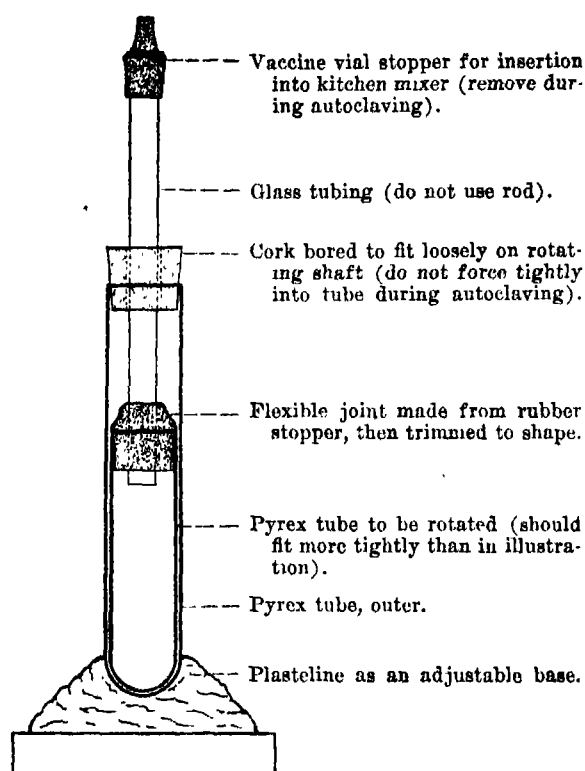


FIG. 1. Grinding Device ( $\frac{1}{2}$  natural size). The outer tube is plugged with cotton and sterilized separately to facilitate loading with cultures or tissues. The inner tube assembly is sterilized in a full-length test tube and transferred into the outer tube aseptically when the materials are ready for grinding. Since each pair of inner and outer tubes is ground together, the tubes are given the same number to prevent accidental interchanges.

is hollow to permit expansion of gases during autoclaving, which should be done with the small rubber cap removed. A standard kitchen mixer is used to rotate the grinding tube, but the terminal fittings for this tube can readily be adapted to any source of power. The size of the tubes and the relative length of the inner tube can be varied to suit almost any amount of material.

Due to the large grinding surfaces, the diluting fluids can be added rapidly by simply sliding the sterile cork up the shaft, rotating at low speed while fluid is added, and then giving a final brief spin while the inner tube is raised and lowered in the outer one a few times. Removal of the inner tube and substitution of sterile stoppers into the flamed mouth of the outer tube permits ready access to the suspensions.

The amount of silica liberated through the abrasive action of the two grinding tubes varies with the conditions of operation. If the two tubes are separated by water only, they produce suspensions of silica which are fine enough to remain in virtually complete

suspension for considerable periods of time. When cultures of acid-fast bacteria are being ground to a smooth paste, the tubes are lubricated by the bacteria and do not liberate perceptible amounts of silica. The amount that is liberated in the grinding of tissues is influenced by the amount of tissue (more tissue, less silica) and by the period of grinding. Best results are obtained with just enough fluid or material to fill the space between the tubes. For some purposes silica suspensions may be desired and for others they must be guarded against.

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### DENATURATION OF EGG ALBUMIN BY PRESSURE

BRIDGMAN's<sup>1</sup> observation that the white of egg becomes coagulated by high hydrostatic pressure suggested that egg albumin is denatured by pressure. Late in 1939 and early in 1940 the writers made a preliminary study of the subject of the exposure of -SH linkages by high pressures to verify the effects of denaturation by pressure.

Twenty grams of Merek's impalpable powdered egg albumin were dissolved in 500 milliliters of water and the mixture dialyzed under toluene, filtered four times through a filter cell, twice through filter paper and stored finally under toluene. Ten cc samples were subjected to pressures ranging from 1,000 to 7,500 kg/cm<sup>2</sup>, the samples being submerged under sterile mineral oil in the pressure chamber to separate from the pressure transmitting liquid. In every case the solutions were coagulated by the pressure treatment, the amount of coagulation becoming more copious the higher the pressure.

The exposure of -SH linkages was verified in two ways after the pressure treatment. Using the 2-6 dichlorophenolindophenol dye in the manner of Todrick and Walker<sup>2</sup> it was observed that the bleaching effect increased with the magnitude of the pressure used for the treatments. Some of the tests were made using the Kassel and Brand<sup>3</sup> modification of Folin and Marenzi's<sup>4</sup> technique. These also showed exposure of -SH groups. Circumstances did not permit further quantitative study of these interesting preliminary observations.

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<sup>1</sup> P. W. Bridgman, *Jour. Biol. Chem.*, 19: 511, 1914.

<sup>2</sup> Todrick and Walker, *Biochem. Jour.*, 31: 292, 1937.

<sup>3</sup> Kassel and Brand, *Jour. Biol. Chem.*, 125: 115, 1938.

<sup>4</sup> Folin and Marenzi, *Jour. Biol. Chem.*, 83: 102, 1929.





**I. A. B. I. 75.**

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